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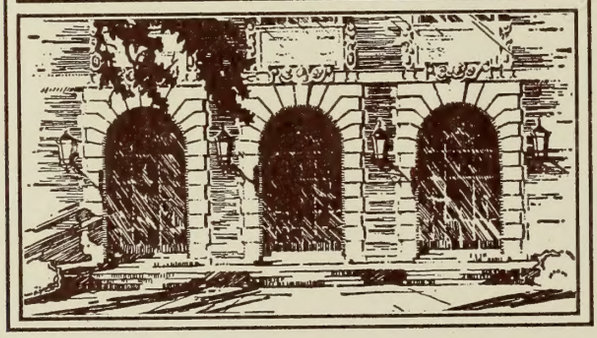

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 13
JULY 1, 1970

W70-05044 -- W70-05546

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign), single copy price is $3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 13
JULY 1, 1970

W70-05044 -- W70-05546

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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01 NATURE OF WATER
Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE
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03 WATER SUPPLY AUGMENTATION AND CONSERVATION
Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL
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05 WATER QUALITY MANAGEMENT AND PROTECTION
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06 WATER RESOURCES PLANNING
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07 RESOURCES DATA
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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

THE ROLE OF COAGULATION IN NATURAL WATERS,
Harvard University, Cambridge, Mass. Div. of Engineering and Applied Physics.
For primary bibliographic entry see Field 02K.
W70-05472

02. WATER CYCLE

2A. General

ENERGY AND MOISTURE BALANCES OF AN ALPINE TUNDRA IN MID-JULY,
California Univ., Los Angeles. Dept. of Geography.
Werner H. Terjung, Ronald N. Kickert, Gerald L. Potter, and Stanley W. Swarts.
Arctic and Alpine Research, Vol 1, No 4, p 247-266, 1969. 20 p, 16 fig, 2 tab, 47 ref.

Descriptors: *Energy budget, *Tundra, *Mountains, *California, Heat balance, Heat budget, Solar radiation, Albedo, Weather, Evaporation, Evapotranspiration, Temperature, Thermoperiodism.
Identifiers: Alpine tundra, White Mountains (Calif).

The daytime budget of energy and moisture has been constructed for an alpine tundra at 37 deg 33 ft 50 in N, 118 deg 13 ft 45 in W at about 3,580 m elevation in the White Mountains of California during mid-July. Parameters observed were direct and diffuse solar radiation on a horizontal surface, on slopes of 45 deg and 90 deg for the cardinal directions, and albedo. Net radiation was measured over the tundra interface and the water surface of a pond. Radiant temperatures (or counterradiation) and the actual surface temperature (or terrestrial radiation) were utilized to derive 'environmental radiant temperature.' This index proved to be of much greater utility than air temperature. Other data included soil temperatures and logarithmic wind profiles. The disposition of net radiation (minus soil heat flux) via sensible and latent heat flux (evapotranspiration) were computed via the Bowen ratio and aerodynamic equations. A series of highly correlated empirical relationships between the data are presented, together with a daily budget of input and output. The data indicate that the alpine tundra undergoes one of the greatest energy fluctuations observed on this planet. (Knapp-USGS)
W70-05068

ANALOG COMPUTER SIMULATION OF THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED,
Utah Water Research Lab., Logan.
V. V. Dhruva Narayana, J. Paul Riley, and Eugene K. Israelsen.
Available from the Clearinghouse as PB-190 483, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report PRWG 56-1, Utah Water Research Laboratory, January 1969. 83 p. OWRR Project B-016-UTAH.

Descriptors: *Urban hydrology, *Simulation of urban hydrology, *Hydrologic models, *Electronic analog computer, *Storm drain design, *Flood frequency, *Urban parameters, *Runoff characteristics, Simulation, Watershed studies, Hydrology, Hydrologic research, Computer simulation, Surface runoff, Precipitation, Urban watershed, Equivalent rural watershed, Percentage impervious cover, Characteristic impervious length factor, Texas.
Identifiers: Waller Creek watershed, Austin (Tex).

In the synthesis of hydrograph characteristics of small urban watersheds, the distribution of water among the various phases of the runoff process is attempted by the concept of equivalent rural watershed. The urban parameters considered in the study are percentage impervious cover and characteristic impervious length factor. A mathematical model is developed for the equivalent rural watershed with precipitation as input. The hydrograph of outflow is obtained by chronologically deducting the losses due to interception, infiltration, and depression storages from precipitation and then routing through the watershed storage. This mathematical procedure is programmed on an analog computer and is tested with data from the Waller Creek watershed, at Austin, Texas. In the verification process, watershed coefficients representing interception, infiltration, and depression storage are established by trial and error such that the simulated and observed hydrographs are nearly identical with a high statistical correlation. Sensitivity studies indicate the relative influence of the watershed coefficients on the runoff process. The watershed coefficients determined by model verification for each year of study are related to corresponding urban parameters.
W70-05118

COMPUTER SIMULATION OF THE HYDROLOGIC SYSTEM OF A MOUNTAIN WATERSHED,
Montana Water Resources Research Center, Bozeman.
For primary bibliographic entry see Field 07C.
W70-05125

EFFECTS OF BANK SEEPAGE ON FLOOD HYDROGRAPHS,
Kansas Water Resources Research Inst., Manhattan.
Ernest C. Pogge.
Available from the Clearinghouse as PB-190 575, $3.00 in paper copy, $0.65 in microfiche. Kansas State University Water Resources Research Institute Project Completion Report, Contribution No 33, 1968. 42 p, 7 fig, 5 tab, 2 ref, 2 append. OWRR Project No A-018-KAN.

Descriptors: *Hydrograph analysis, *Mathematical models, *Bank storage, Base flow, Floods, Recharge, Groundwater movement, Surface-groundwater relationships, Water levels, Aquifers, Alluvial channels, Computer programs, Computer models, Recession curves.
Identifiers: Bank seepage, Flood hydrographs.

Two analytical methods for determing the change in groundwater levels, bank seepage and the amount of bank storage that occurs at a particular location in an alluvial aquifer during the passage of a flood wave were used to develop bank seepage models for the digital computer. One of the models utilizes an asymmetric sine curve to approximate the flood-wave hydrograph. The other model utilizes linear segments to simulate the flood-wave hydrograph. Both models were developed for an idealized alluvial aquifer and for limited boundary conditions. The models were tested using the same input data for both and comparing simulated groundwater levels, bank seepage, and bank storage to verify the mathematical derivations and computer programs and show the advantages and disadvantages of each of the models. (Knapp-USGS)
W70-05126

RUNOFF FORECASTS BY LINEAR PREDICTIVE FILTER,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
Mikio Hino.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7146, p 681-702, March 1970. 22 p, 13 fig, 1 tab, append.

Descriptors: *Runoff forecasting, *Rainfall-runoff relationships, *Streamflow forecasting, *Statistical models, Probability, *Unit hydrographs, Statistical methods, Hydrograph analysis, Hydrographs, Hyetographs, Rainfall intensity, Frequency analysis.
Identifiers: Linear predictive filter (Statistical).

The optimal unit hydrograph is shown to be the weighted sum of each runoff component which constitutes the crosscovariance. Statistical properties of hydrological data such as autocovariance, crosscovariance, spectrum, coherence and phase angle are investigated to apply the prediction method practically. It is shown that the autocovariance of daily rainfall may be roughly approximated by the Dirac delta function. The crosscovariance of rainfall and runoff analyzed in this paper is composed of two runoff components of short and long periods. The coherence of rainfall and runoff is nearly unity for light rainfall suggesting that the rainfall-runoff process may be approximated by a linear system. On the other hand, the coherence becomes worse as the rainfall intensity increases; there is a gap of coherence in the middle frequency range. Examples of runoff prediction by the theory are given. (Knapp-USGS)
W70-05139

LAMINAR AND TURBULENT OVERLAND FLOW HYDROGRAPHS,
Cornell Univ., Ithica, N.Y.
James R. Morgali.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7069, p 441-460, February 1970. 20 p, 17 fig, 21 ref, append. FWPCA Research Grant WP-00948-02.

Descriptors: *Overland flow, *Mathematical models, *Computer models, Rainfall-runoff relationships, Hydrograph analysis, Unit hydrographs, Dimensional analysis, Laminar flow, Turbulent flow, Critical flow, Rainfall intensity.
Identifiers: *Kinematic wave theory.

A computer-solved mathematical model may be used to synthesize flow. An application of the kinematic flow assumptions is used for analysis of experimental overland-flow hydrograph data. The results of this analysis give an indication of flow regime, roughness, and the nature of the change from laminar to turbulent flow. The hydrographs are put in dimensionless form using the rainfall and the kinematic time to equilibrium as normalizing factors. Included is an anlaysis of a computer-solved mathematical model. The results from the data analysis are used in this model to synthesize a turbulent and a laminar hydrograph which compare favorably with the original experimental data. (Knapp-USGS)
W70-05152

MOVABLE BED MODEL FOR ALLUVIAL CHANNEL STUDIES,
Corps of Engineers, Omaha, Nebr.
For primary bibliographic entry see Field 02J.
W70-05192

STATISTICAL EVALUATIONS OF A CLOUD-SEEDING PROGRAM AT THE STREAMFLOW CONTROL LEVEL,
Washington State Univ., Pullman; and State of Washington Water Research Center, Pullman.
Millard Hastay, and John S. Gladwell.
J Hydrol, Vol 9, No 2, p 117-135, 1969. 19 p, 2 fig, 8 tab, 9 ref.

Descriptors: *Weather modification, *Cloud seeding, Rain gages, Silver iodide, Snowfall, *Streamflow, Streamflow records, Statistical analysis, Atmospheric precipitation, *Runoff, *Evaluation, Streamflow forecasting, Mathematical analysis, Winter.
Identifiers: Snow gages, Stream gaging station, *Skagit River (Wash), Silver iodide generators.

During the winters of 1962-63 and 1963-64, cloud seeding operations were undertaken on the Skagit River, Wash, watershed. Conditions required that a statistical evaluation be made at the streamflow control level. A combination of least squares regression with principal components analysis was developed, requiring preliminary screening of variables using a liberal (0.10 level of significance) critical region, followed by the orthogonalization procedure of principal components. Final stepwise regression analysis using the principal component scored and the 0.05 level of significance followed. Tests were consistent with treating the residuals as Gaussian, homoscedastic, and nonautocorrelated. The analysis was replicated in various ways. Without exception, the excess of overpredicted flows for the full period of the experiment was significant at 0.01 or higher level. Whereas the excess in 1964 is invariably significant at the 0.005 or higher level, the 1963 excess would not be judged significnt by itself at the 0.05 level. This is explained by a 5-fold increase in seeding between 1963 and 1964. Records of 2 yr subsequent to the period of seeding are analyzed; observed flows failed to show significant deviations from expected flows. Estimates indicated at least 15% runoff increase from seeding. (USBR)
W70-05221

MODELLING PARTIALLY PENETRATING RIVERS ON AQUIFER MODELS,
Birmingham Univ. (England). Dept. of Civil Engineering.
Robin Herbert.
Ground Water, Vol 8, No 2, p 29-36, March-April 1970. 8 p, 9 fig, 10 ref.

Descriptors: *Surface-groundwater relationships, *Analog models, Water levels, Base flow, Discharge (Water), Induced infiltration, Model studies.
Identifiers: Aquifer models, Partially penetrating rivers.

A technique is presented for simulating partially penetrating rivers on two-dimensional resistance-capacitance network analog aquifer models. The method is tested against an analytic solution due to Boulton (1942). Several results are presented which can be used to estimate an approximate value for the steady state discharge of a well pumping near a partially penetrating river. (Knapp-USGS)
W70-05478

ESTIMATING THE GROUND-WATER CONTRIBUTION TO STORM RUNOFF BY THE ELECTRICAL CONDUCTANCE METHOD,
Illinois State Water Survey, Urbana.
Adrian P. Visocky.
Ground Water, Vol 8, No 2, p 5-10, March-April 1970. 6 p, 7 fig, 12 ref.

Descriptors: *Storm runoff, *Base flow, *Monitoring, *Water quality, Leaching, Infiltration, Rainfall-runoff relationships, Surface-groundwater relationships, Electrical conductance, Hydrographs, Peak discharge.
Identifiers: Base flow estimation.

The feasibility of determining the groundwater contribution to stream flow during periods of storm runoff by continuous monitoring of a stream's electrical conductance was investigated. The groundwater contribution can be estimated if stream flow and the conductance of surface water and of groundwater are known. The conductance method was tested on a 95-square-mile basin in north-central Illinois. Continuous records of stream flow, stream-flow conductance, and groundwater stage within the basin were collected. A rating curve of base flow versus mean groundwater stage was constructed, and groundwater discharges determined from the rating curve were compared with those computed from conductance data. The conductance method normally gave a lower estimate of the groundwater contribution than did the rating-curve method. However, analyses of storms which were preceded by extended dry periods resulted in much lower estimates of groundwater discharge by the rating-curve method than by the conductance method. The conductance method offers a simple alternative for use in areas where observation wells are unavailable or where rating curves are difficult to construct. (Knapp-USGS)
W70-05481

REGIONAL GROUNDWATER FLOW-OLD WIVES LAKE DRAINAGE BASIN, SASKATCHEWAN,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02F.
W70-05485

2B. Precipitation

ON THE RELATION BETWEEN DROP SIZE AND CONCENTRATION OF TRACE ELEMENTS IN RAINWATER,
Frankfurt Univ. (West Germany). Institut fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 02K.
W70-05132

STATISTICAL EVALUATIONS OF A CLOUD-SEEDING PROGRAM AT THE STREAMFLOW CONTROL LEVEL,
Washington State Univ., Pullman; and State of Washington Water Research Center, Pullman.
For primary bibliographic entry see Field 02A.
W70-05221

THE ECONOMIC IMPACT OF DROUGHTS ON WATER SUPPLY SYSTEMS IN THE PASSAIC RIVER BASIN, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Meteorology.
A. Vaughn Havens.
New Jersey Agricultural Experiment Station, College of Agriculture and Environmental Science, Rutgers - The State University, December 1969. 114p, 19 tab, 31 fig, 41 ref.

Descriptors: *Droughts, *Economic impact, *Hydrologic aspects, *Meteorology, Costs, Biochemical oxygen demand, Dissolved oxygen, River flow, Temperature, Nitrogen compounds, Effective precipitation, Water purification, Regression analysis.
Identifiers: Palmer Drought Index, Passaic Valley Water Commission.

The two objectives of this study are (1) to investigate the relationship between water treatment cost and selected hydrologic and meteorologic variables associated with, and indicative of, drought, and (2) to determine the effect of drought on water treatment cost. The variables studied were: economic-river water chemical treatment cost; hydrologic-biological oxygen demand, dissolved oxygen, stream flow, water temperature, and ammonia; and meterologic-Palmer Drought Index and precipitation. Time series and correlation analyses revealed some basic information on the simple relationships between all the variables. Graphic analysis was also utilized to determine the relationships between the various variables. Estimates of the cost of drought at the Passaic Valley Water Commission for the January 1961 - December, 1966, period. Extensive tables of data and graphs are included. (Grossman-Rutgers)
W70-05275

STATISTICAL ANALYSIS AS A FLOOD ROUTING TOOL,
Weather Bureau, Salt Lake City, Utah. Western Region.
For primary bibliographic entry see Field 02E.
W70-05316

PARK RANGE: ATMOSPHERIC WATER RESOURCES PROGRAM,
EG and G, Inc., Boulder, Colo., Environmental Services Operation.
For primary bibliographic entry see Field 03B.
W70-05317

2C. Snow, Ice, and Frost

PHYSICAL PROPERTIES AND INTERNAL STRUCTURE OF GREENLAND SNOW,
Army Terrestrial Sciences Center, Hanover, N.H.
Ukichiro Nakaya, and Daisuke Kuroiwa.
Report available from Cold Regions Research and Eng Lab, Hanover, New Hampshire 03755. Cold Regions Research and Engineering Laboratory Research Report 89, January 1970. 33 p, 25 fig, 1 tab, 21 ref. DA Task 1T061102B52A02.

Descriptors: *Snow, *Snowpacks, *Arctic, Density stratification, Physical properties, Glaciers, Firn, Bulk density, Density, Diffusivity, Porosity, Rheology, Permeability, Elasticity (Mechanical), Strength.
Identifiers: *Greenland, Snow properties.

Experiments were carried out near Thule, Greenland, on the correlation between the physical properties and internal structure of snow. About 150 snow samples obtained to 26 m depth were measured for elastic modulus, air permeability, unconfined compressive strength, and static compression and creep. The observed density profile curve deviated from the theoretical curve at a depth of 10 m and density of 0.52 g/cc, a value almost equivalent to the limiting density obtainable by simple mechanical packing. Therefore, further densification must proceed through plastic flow in grains. A similar critical depth was observed in the vertical distribution of Young's modulus. A positive correlation was found between Young's modulus and density, and an inverse correlation between average grain diameter and Young's modulus or density. There were reciprocal correlations between air permeability and density or unconfined compressive strength, and between the number of grains and their average diameters. Kozeny's constant of Greeland snow was obtained from air permeability values and the length of peripheries of cross sections of grains. Basal slip, buckling, cell or sub-grain formation, recrystallization and grain boundary migration occurring during plastic deformation of snow texture were observed by static compression of thin section snow under the microscope. (Knapp-USGS)
W70-05129

A HEAT BUDGET OF THE WATER IN BARROW STRAIT FOR 1962,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
A. Huyer, and F. G. Barber.
Marine Sciences Branch, Department of Energy, Mines and Resources, Manuscript Report Series No 12, Ottawa, Canada, 1970. 43 p, 11 fig, 8 tab, 61 ref.

Descriptors: *Heat budget, *Heat transfer, *Ocean circulation, *Arctic, *Alaska, Solar radiation, Advection, Cold regions, Sea ice.
Identifiers: *Barrow Strait (Canada).

A heat budget was computed for the water in Barrow Strait, Canada. Radiation and other meteorological observations were made on nearby Cornwallis Island. The oceanography and especially the water movements of the region are little known. A net water transport to the eastward occurs in Barrow Strait; however, the data are largely qualitative and, in the main, are restricted to the period of the navigation season. A strong (2 knot) westward moving current can occur close inshore in Barrow Strait off Resolute, at least for short periods of 2 to 3 days. A small westward movement occurs at the surface between Cornwallis and Griffith Islands with a general eastward movement throughout the remainder of Barrow Strait.

Although icebergs have been observed as far west as Barrow Strait, it is believed that the main surface drift is eastward. Due to topography this drift comprises water from the upper 150 m in the Arctic Ocean. As this water is close to the freezing point, the movement should contain little sensible heat. A consideration of the movement which likely occurs through Jones Sound and Smith Sound led to a similar conclusion, that water transport into Baffin Bay from the Arctic Ocean does not contribute significant sensible heat to Baffin Bay. (Knapp-USGS)
W70-05136

FOUNDATIONS AND SUBSURFACE STRUCTURES IN SNOW,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 08A.
W70-05302

ANNUAL REPORT NO. 1,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
Nobert Untersteiner, Phil Church, Gary Maykut, Roger Evans, and John Kelley.
Available from the Clearinghouse as AD-699 144, $3.00 in paper copy, $0.65 in microfiche. Report (Period: Oct 1, 1968-Sep 30, 1969), 1 Dec 69, 27 p.

Descriptors: *Sea ice, Arctic, Stress, Mathematical models, Turbulent boundary layers, Ablation, Cracks, Carbon dioxide, Albedo, Micrometeorology, Air-water interfaces.
Identifiers: Atmospheric temperature, Thickness.

The phase-out of routine collections of field data has enabled the Laboratory to concentrate on data analyses and publications. Three new projects, directly applicable to practical problems, have been initiated- (thermal cracks in sea ice, critical Richardson number and frictional coupling between air and ice, and the creep mechanism of polycrystalline ice). The outline of a plan to study the large-scale dynamics of sea ice was prepared under the code name AIDJEX (Arctic Ice Deformation Joint Experiment). Previous work has dealt with the stresses of air and water on the ice and with the exchange of heat between the three media. If this materializes, current activities would require little adjustment to be integrated into the overall objectives of AIDJEX.
W70-05313

ICE THICKNESS OBSERVATIONS, NORTH AMERICAN ARCTIC AND SUBARCTIC 1964-65, 1965-66. PART IV,
Cold Regions Research and Engineering Lab., Hanover, N.H.
Michael A. Bilello, and Roy E. Bates.
Available from the Clearinghouse as AD-699 328, $3.00 in paper copy, $0.65 in microfiche. Special Rept. No. CRREL-SR-43-Pt-4, Nov 69, 134 p.

Descriptors: *Arctic, *Ice, Measurement, Rivers, Networks, Sea ice, Weather forecasting, Lakes, Maps, Lake ice, Winter.
Identifiers: Remote areas, River ice, Alaska, Canada.

The report is fourth in a series of reports on lake and river ice land-fast sea ice records ice thickness observed throughout the North American arctic and subarctic during the 1964-65 and 1965-66 seasons. Information on ice surface conditions, dates of first ice, freeze-over and breakup, and detailed measurements of ice thickness across Alaskan rivers are also included. First reports from the Alaska National Guard on Ice thickness measurements on lakes and rivers in the remote regions of interior Alaska are presented. Analyses on maximum observed ice thicknesses reported during the two winters in North America and deviations from the mean ice thickness amounts measured across Alaska rivers between 1961 and 1966 were conducted.
W70-05314

THE EFFECT OF DISTURBANCE ON PERMAFROST TERRAIN,
Cold Regions Research and Engineering Lab., Hanover, N.H.
Jerry Brown, Warren Rickard, and Donald Victor.
Available from the Clearinghouse as AD-699 327, $3.00 in paper copy, $0.65 in microfiche. Special Rept. No. CRREL-SR-138, Nov 69, 18 p.

Descriptors: *Permafrost, Stresses, *Soil investigation, Erosion, Degradation, Ice, Melting, Drainage, Foundations, Cracks, Buildings, Plants (Botany), Swamps, Damage, Penetration, Tundra, Earth moving equipment, Terrain analysis.
Identifiers: Peat, Arctic soils, Alaska, Fire damage.

The influence of surface cover on thaw penetration in alpine and arctic soils of Alaska was determined. Several manipulated treatments were employed: removal of all vegetation, mulching, shearing and fire. Thaw and subsidence more than doubled on the bare and sheared plots and increased up to 50% on the burned areas. Bulldozing of and traffic over ice-rich permafrost terrain resulted in considerable erosion and thaw.
W70-05315

A PHOTOELECTRIC SNOW PARTICLE COUNTER,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
R. A. Schmidt, and R. A. Sommerfeld.
Western Snow Conference, Salt Lake City, Utah. Proceedings, April 15-17, 1969, v. 37, p 88-91.

Descriptors: *Instrumentation, *Snow, Precipitation gage, Bridge (Electronic), *Snowfall, Colorado.
Identifiers: Snow particle counter.

To count individual snow particles transported by wind, an instrument was designed using a light beam and photo-transistors. Two light sensors were incorporated to determine particle speed. An integrated circuit operational amplifier provides an output from the photo-transistor bridge circuit. The output is recorded on magnetic tape. (Schmidt-Forest Service).
W70-05457

EXPERIMENTAL LARGE-SCALE SNOW AND ICE MAPPING WITH COMPOSITE MINIMUM BRIGHTNESS CHARTS,
National Environmental Satellite Center, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-05522

2D. Evaporation and Transpiration

EVAPORATION NORMS FROM WATER RESERVOIRS,
State Hydrological Inst., Moscow (USSR).
A. P. Braslavskii, and Z. A. Vikulina.
GIMIZ Leningrad 1954, Engl. Transl. Israel Program for Scientific Translations, Jerusalem 1963, 217 p, 24 fig., 94 tab., 77 ref, append.

Descriptors: *Evaporation, *Reservoirs, *Heat balance, Temperature, Climatology, Climatic data, Heat budget, Environmental effects, Climatic zones, Reservoir evaporation, Air-water interfaces, Evaporation pans, Hydrologic cycle, Vapor pressure, Latent heat, Winds, Wind velocity, Turbulence, Humidity, Dew point.
Identifiers: USSR Reservoirs.

The monograph is the result of research carried out by the GGI (State Hydrological Institute) aimed at developing a method for the calculation of evaporation from the surface of reservoirs. Methods are presented for calculating the various meteorological elements of the hydrologic regime of water reservoirs, including evaporation, by taking into consideration the water balance and the relevant physical characteristics of the reservoir. The results of such calculations of evaporation have been mapped and a series of tables and nomograms, simplifying the calculations are given. A heat balance method for calculating the temperature of a reservoir was developed and computation of necessary parameters for different regions of the USSR presented. (Novotny-Vanderbilt)
W70-05056

PHYSICAL, METEOROLOGICAL, AND HYDROLOGIC ASPECTS OF EVAPOTRANSPIRATION,
Clemson Univ., S.C. Water Resources Research Inst.
Jerry R. Lambert.
Available from the Clearinghouse as PB-190 573, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute, Clemson University, Report No. 14, p. 1-59, March 1970. 20 fig, 1 tab, 5 ref. OWRR Project B-001-SC.

Descriptors: *Evapotranspiration, *Lysimeters, *Transpiration control, *Water yield improvement, Soil water movement, Energy budget.
Identifiers: Plant water physics.

The flow of water through an individual plant was treated as a hydraulic system. Unsaturated flow of water to a plant rate was assumed. A solution predicting the rate of soil moisture extraction by a single plant was developed. Experimental data did not confirm this solution, probably because of error in establishing the experimental parameter. A 1 inch-thick acrylic infrared filter was used over a weighing lysimeter in determining the effects of reducing infrared radiation on evapotranspiration. An energy budget and experimental data confirmed the reduction of evapotranspiration rates over a 48-hour period to one-quarter that of the control lysimeters. The use of phenylmercuric acetate for transpiration control and possible subsequent increased water yield was attempted on a 3.5-acre watershed. Both ground- and aerial-operated spraying reflected only short term (four week) effects as measured by pressure infiltration on short-leaf and loblolly pine. (Lambert-Clemson)
W70-05123

A STUDY OF THE EFFECTS OF WAVES ON EVAPORATION FROM FREE WATER SURFACES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
Calvin C. Easterbrook.
Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 65 cents. Bureau of Reclamation Research Report No. 18, 1969. 58 p, 38 fig, 12 ref, 5 append. USBR Contract 14-06-D-5764.

Descriptors: *Evaporation, *Waves (Water), *Reservoir evaporation, Evaporation control, Waves, Wind tunnels, Wind velocity, Wind speed, Water vapor, Water temperature, Lakes, Laboratory tests, Field investigations.
Identifiers: *Evaporation coefficient, *Wave height, Evaporation tanks, Lake Hefner (Okla), Wave tanks, Mass transport.

The evaporation rate from a water surface is shown to be greatly affected by surface waves in laboratory and field tests. Laboratory experiments were made using a large wave tank-wind tunnel apparatus in which both wind speed and wave parameters could be controlled. The apparatus simulates wave conditions on large bodies of water with fetches up to a mile or more. Tank experiments indicate certain combinations of wind speed and well-developed waves produce an evaporation rate lower than the rate under similar wind conditions with no waves present. Investigations of air flow over the waves show that, as wave heights increase, regions of dead air are observed leeward of wave crests, and vortices appear in the wave troughs. The partially trapped air apparently forms an effective barrier to the vertical transport of water vapor. Wave and evaporation measurements at Lake Hefner, Oklahoma, were very similar to the

laboratory measurements. The Lake Hefner data were adjusted to previously measured evaporation coefficient relationships derived from water and energy budget measurements. The resulting evaporation coefficient curve is believed to give an improved measure of the instantaneous evaporation rate from Lake Hefner under given conditions for wind speed, water surface temperature, and ambient humidity.
W70-05208

THE CLIMATOLOGY OF SOIL MOISTURE, EVAPORATION, AND NON-MOISTURE STRESS DAYS FOR CORN IN IOWA,
Environmental Science Services Administration, Rockville, Md.; and Iowa State Univ., Ames.
Robert F. Dale.
Agricultural Meteorology, Vol 5, No 2, p 111-128, March 1968. 12 fig, 7 tab, 12 ref.

Descriptors: *Climatology, *Corn (Field), *Crop production, *Soil moisture, *Evaporation, Moisture availability, Moisture stress, Evapotranspiration, Weather, Precipitation (Atmospheric), Iowa, Corn Belt, Estimating, Phenology, Soil-water-plant relationships, Variability.
Identifiers: *Potential evapotranspiration, *Non-moisture stress.

The study is concerned with the possibility of utilizing for regional agricultural planning a method which considers the interaction upon corn crops of potential evapotranspiration, soil moisture, and ease of extraction of available water. Climatology of the number of days with no moisture stress in the critical growth period of corn is given for four Iowa locations. Climatology of the input variables is described for these same four stations. Input variables consist of evaporation, precipitation, and soil moisture under corn. Using the non-stress day climatology it was demonstrated that areas of higher than average precipitation had a higher frequency of unfavorable weather and lower corn yields caused by moisture stress. (Carr-Arizona)
W70-05286

OBSERVED AND ESTIMATED EVAPOTRANSPIRATION IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
E. H. Hobbs, and K. K. Krogman.
American Society of Agricultural Engineers, Transactions, Vol 11, No 4, p 502-503, 507, July-August 1968. 3 p, 2 fig, 8 ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Irrigation, *Irrigation practices, *Estimating, Semiarid climates, Grasslands, Wheat, Alfalfa, Sugar beets, Potatoes, Grasses, Data collections, On-site investigations, Scheduling, Soil moisture.
Identifiers: *Alberta (Canada).

Recent studies of consumptive use of water by crops have related measured evapotranspiration to various meteorological parameters. These relationships provide a method of estimating evapotranspiration for irrigation scheduling and applying the data to other prairie areas, thus eliminating the measurement of evapotranspiration at each locality. Measured evapotranspiration is given for five crops (alfalfa, grass, potatoes, soft wheat, and sugar beets) and the data are compared with potential evapotranspiration. Transfer value of the data is discussed, based on the ratio of measured to potential evapotranspiration. (Carr-Arizona)
W70-05293

TRANSPIRATIONINTENSITY AS RELATED TO VEGETATION ZONATION IN THE WHITE MOUNTAINS OF CALIFORNIA,
California Univ., Los Angeles. Dept. of Botanical Sciences.
H. A. Mooney, Robert Brayton, and Marda West.
American Midland Naturalist, Vol 80, No 2, p 407-412, October 1968. 1 fig, 2 tab, 3 ref.

Descriptors: *Transpiration, *Elevation, *Vegetation, *Desert plants, *Conifers, Altitude, Arid lands, California, Soil moisture, Water loss, Environmental effects, Greenhouses, On-site data collections, Tundra, Climatic zones.
Identifiers: *Transpiration rates, *Vegetation zones, *Growth forms, *Deciduous plants,*Evergreens, White Mountains (Calif).

Transpiration rates weremeasured both insitu and in a greenhouse environment for native plants growing at 5,000 to 12,000-foot elevations in the White Mountains of California. Vegetation zones included in the study ranged from desert scrub to alpine tundra. Highest rates of transpiration occurred in two desert shrub species; lowest rates were in the conifers of the two middle zones. Thus there is no clear sequence of rate intensity as related to elevation. However, a relationship does appear between transpiration rate and growth form. Desert summer deciduous shrubs transpire intensely during growth periods when water is available. When water is limited, there is a loss of leaves, thereby decreasing the amount of transpiring surfaces. Evergreen desert shrubs have a much lower rate of water loss, as do evergreens at higher elevations. (Carr-Arizona)
W70-05299

EVAPORATION AND ITS SUPPRESSION BY CHEMICAL FILMS AT LAKE HEFNER,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03B.
W70-05300

2E. Streamflow and Runoff

STRATIFIED RESERVOIR CURRENTS: PART I, ENTERING STREAMFLOW EFFECTS ON CURRENTS OF A DENSITY STRATIFIED MODEL RESERVOIR,
Oregon State Univ., Corvallis. Engineering Experiment Station.
E. H. Elwin, and L. S. Slotta.
Bulletin No. 44, October, 1969. 97 p, 29 fig, 31 ref, 3 append.

Descriptors: *Stratification, *Reservoir, *Model studies, Flow rate, Temperature, Reynolds number.
Identifiers: Density profiles, *Current patterns.

An experimental study of entering streamflow effects on currents of a density stratified model reservoir was made. Experiments were performed using various concentrations of a sodium chloride solution to provide linear density stratification. Flow field current patterns and velocities were determined photographically. For the range of values tested, the entering model streamflow created two possible main inflow density currents in the model reservoir. The upper inflow current increased its magnitude and lower inflow current decreased its magnitude as the model streamflow Reynolds number increased. These currents could be described in terms of V1 max and V3 max, the maximum inflow current velocity and maximum mixing current velocity respectively; h1 and h3, the depth of these two currents respectively; v is the kinetic viscosity of reservoir fluid; V is the inflow velocity; D/ (D-h), is the density scaling factor; and (rho max) and (rho o) is the maximum density and initial density of the fluid and b is the width of inflow current. The lower inflow current will no longer occur at a model streamflow number greater than Vb/v = 150000 ((D-h)/D). The interaction between two reservoir density currents created a significant reinforcement of both currents. (See W70-05049). (Upadhyaya-Vanderbilt)
W70-05048

STRATIFIED RESERVOIR CURRENTS: PART II, THE NUMAC METHOD FOR NON-HOMOGENEOUS UNCONFINED MARKER-AND-CELL CALCULATIONS,
Oregon State Univ., Corvallis. Engineering Experiment Station.
M. D. Terry, H. T. Mercier, and L. S. Slotta.
Bulletin No. 44, October 1969. 61 p, 17 fig, 12 ref.

Descriptors: *Hydrodynamics, Density, Reservoirs, *Model studies.
Identifiers: *Algorithm, Salt water wedge, Over-relaxation factor, *Boundary conditions, Velocity profiles, Viscosity effect.

A marker and cell method was employed in a system containing two discrete fluids using a mixed Eulerian-Lagrangian scheme. The velocity and pressure were considered as Eulerian variables and found at the mesh points of a fixed grid. The density was considered a Lagrangian variable and was localized to fluid particles. The method may be used for computations involving nonhomogeneous, incompressible viscous fluids. The current version of NUMAC admits only boundaries that are expressible in terms of the grid, i.e., those which have been 'rectangularized'. If circular or oblique boundaries are desired, the boundary must be approximated in terms of grid. Standard techniques in the numerical solution of partial differential equation may then be used to apply to the oblique or circular boundary conditions in the boundary cells. New boundary conditions which are useful in hydrodynamic or oceanographic simulation are presented. A flow chart and a listing for those interested in implementing the method are included. (See W70-05048). (Upadhyaya-Vanderbilt)
W70-05049

GRAPHICAL SOLUTION OF HYDRAULIC JUMP,
Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05060

LIMIT SLOPE IN UNIFORM FLOW COMPUTATIONS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W70-05061

NUMERICAL METHOD OF COMPUTING FLOW PROFILES,
Indiana Dept. of Natural Resources, Indianapolis. Surface Water Section.
For primary bibliographic entry see Field 08B.
W70-05062

NUMERICAL SOLUTION OF SAINT-VENANT EQUATIONS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 08B.
W70-05063

MANNING FORMULA -- A MISNOMER,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 08B.
W70-05064

RIVER CHANNEL PATTERNS,
Central Water and Power Research Station, Poona (India).
Shrikrishna V. Chitale.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7038, p 201-221, January 1970. 21 p, 15 fig, 3 tab, 15 ref, append.

Descriptors: *Channel morphology, *Meanders, *Drainage patterns (Geologic), Geomorphology, Rivers, Braiding, Deposition (Sediments), Sediment transport, Sediment load, Bed load.
Identifiers: River channel patterns.

River channel patterns of various types are described and defined. Data for 42 rivers are collected in respect to meander and channel characteristics. Relationships are statistically determined between tortuosity ratio and important channel characteristics. Similar equations are evolved for the ratio of meander belt to channel width. These two ratios define shape and size of a meander. Conditions when channels become straight or meandering are described and it is shown that meandering helps the channel to reach final stability. (Knapp-USGS)
W70-05065

INTEGRATING-FLOAT MEASUREMENTS AT LOW VELOCITIES,
Missouri Univ., Columbia. Dept. of Civil Engineering; and Tennessee Valley Authority, Norris. Hydrology Lab.
For primary bibliographic entry see Field 07B.
W70-05066

GAZETTEER OF HYDROLOGIC DATA FOR THE RIVER ROUGE BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Lansing, Mich.
R. L. Knutilla.
Corps Engineers Southeastern Michigan Water Resources Study, Technical Paper No 1, March 1969. 84 p, 3 fig, 11 tab.

Descriptors: *Water resources, *Surface waters, *Michigan, Data collections, Hydrologic data, Streamflow, Discharge (Water), Water yield, Water quality, Runoff, Low flow, Base flow, Duration curves, Droughts.
Identifiers: *River Rouge (Mich).

Data are compiled for use in the formulation of a plan for the optimum development of the water resources of the southeastern Michigan area. The overall study encompasses an area of about 5,400 square miles. This report is on the River Rouge basin. Streamflow, physiographic, and other data on waters in the basin are presented. Summaries include the following data: station description, table of monthly and yearly mean discharge, table of monthly and yearly runoff, table of yearly discharge, and summaries of flow characteristics including flow duration, low flow, high flow, and deficient discharge. (Knapp-USGS)
W70-05070

WILLAMETTE RIVER AT LAMBERT BEND, OREGON- FLOODFLOW CHARACTERISTICS OF THE PROPOSED GREENACRES ROAD CROSSING,
Geological Survey, Portland, Oreg.
D. D. Harris.
Geological Survey Open-file report, April 1969. 10 p, 2 fig, 5 ref.

Descriptors: *Floods, *Oregon, *Bridges, *Stage-discharge relations, *Backwater, Flood control, Hydraulics, Civil engineering, Channel morphology, Profiles, Flood forecasting, Flood plains.
Identifiers: Willamette River (Ore), Backwater curves.

The proposed crossing of the Willamette River, Oregon, at Lambert Bend involves a 2.3-mile-wide flood plain. Two of the three principal tangents of the crossing will include bridges that will span the main channel and an overflow channel of the river. A design headwater elevation of 100.0 feet (upstream from the proposed constriction) will result in a discharge of 195,000 cfs. The main channel bridge does not contribute any backwater at this elevation. A discharge of 195,000 cfs occurred on the average of once every 3 years prior to 1941. The flood of December 1964 resulted in a discharge of 320,000 cfs at the proposed bridge site. With additional storage now available from three new reservoirs, an equivalent flood event could now be reduced to 261,000 cfs. With this flow, the constricted headwater elevation (at sec. 1) would reach 105.1 feet which includes 0.5 foot of backwater from the overflow bridge. The main channel bridge does not add any significant amount of backwater to this elevation. Before regulation, 261,000 cfs occurred on the average of once every 5 years. (Knapp-USGS)
W70-05072

CONCEPTS FOR THE DESIGN OF STREAMFLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-05073

RUNOFF FORECASTS BYLINEAR PREDICTIVE FILTER,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-05139

CHANNEL SLOPE EFFECT ON PEAK DISCHARGE OF NATURAL STREAMS,
Washington Suburban Sanitary Commission, Hyattsville, Md., and Greenhorne and O'Mara, Inc., Riverdale, Md.
Charles L. Armentrout, and Robert B. Bissell.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7052, p 307-315, February 1970. 9 p, 3 fig, 1 tab, 9 ref.

Descriptors: *Peak discharge, *Runoff forecasting, *Small watersheds, Mathematical studies, Rainfall-runoff relationships, Discharge (Water), Routing, Floods, Flood forecasting, Streamflow forecasting.
Identifiers: Channel slope method.

The 'Channel Slope Method' provides a reasonable approach to the apparent need for a reasonable method of computing peak runoff rates for natural streams. Stream runoff data from the U. S. Geological Survey were correlated with the slope of the stream channel. The data were plotted on logarithmic paper with stream channel slope in feet per mile as abscissa and unit runoff in cubic feet per second per acre as ordinate. A straight line envelopes all the plotted points and gives the equation of the unit runoff for a particular recurrence interval. A conservative estimate of the peak discharge for a given recurrence interval may be made by this method. (Knapp-USGS)
W70-05141

VARIATION IN LAG TIME FOR NATURAL CATCHMENTS,
New South Wales Univ., Sydney (Australia). Dept. of Civil Engineering.
Arthur J. Askew.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7051, p 317-330, February 1970. 14 p, 4 fig, 12 ref, append.

Descriptors: *Routing, *Flood routing, *Rainfall-runoff relationships, Hydrograph analysis, Unit hydrographs, Hydrographs, Runoff forecasting, Streamflow forecasting, Flood forecasting.
Identifiers: Lag (Runoff), Australia.

Lag time for a catchment is shown to be a variable which is strongly correlated with flood magnitude. Values for various parameters of rainfall and runoff were derived from the analysis of records for five small catchment areas. Lag time is defined as the time between the centers of mass of excess rainfall and direct runoff. Weighted mean discharge is used as the measure of average streamflow magnitude. No significant correlation is found between the lag and various characteristics of the areal and temporal distribution of rainfall. Therefore, the lag-weighted mean discharge equations best represent the variable lag time for the catchments studied. (Knapp-USGS)
W70-05142

CHARACTERISTICS OF SELF-AERATED FLOWS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W70-05143

LINEAR PROPORTIONAL WEIRS,
Regional Engineering Coll., Rourkela (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W70-05146

SURVEY OF PROGRAMS FOR WATER-SURFACE PROFILES,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 07C.
W70-05147

EFFECT OF FLUME WIDTH ON BED-FORM CHARACTERISTICS,
Hydraulics Research Station. Wallingford (England).
For primary bibliographic entry see Field 02J.
W70-05150

RIPPLE CONCENTRATION AND FRICTION FACTOR,
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05154

VERTICAL TRANSFER IN OPEN CHANNEL FLOW,
Geological Survey, Fort Collins, Colo.; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-05160

FLOOD PEAKS FROM SMALL SOUTHWEST RANGE WATERSHED,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
Kenneth G. Renard, John C. Drissel, and Herbert B. Osborn.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7161, pp 773-785, March 1970. 13 p, 8 fig, 7 tab, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Peak discharge, Rainfall intensity, Base flow, Meteorology, Frequency analysis, Runoff forecasting, Flood forecasting, Streamflow forecasting, Statistical methods, Discharge (Water), Routing, Hydrograph analysis, Time series analysis.
Identifiers: Flood peaks, Peak flow.

Runoff on the 67-sq-mile Alamogordo Creek Experimental Watershed in northeastern New Mexico is generated from storm precipitation with greatly differing characteristics. The largest peak discharges occurred from a combination of convective heating and weak summer cold fronts. Thunderstorms within frontal systems have produced large peak discharges and runoff volumes, whereas the long-duration summer frontal storms have produced appreciable volumes of runoff, but much lower peak discharges. For a storm duration of less than six hours, the point precipitation frequencies appear to be higher than those published by the U.S. Weather Bureau. The data show the importance of watershed rainfall values as compared to single point values. The five largest runoff events during the 14 yr-record are compared and discussed in relation to precipitation differences. By extrapolation of the available data, using a log-normal frequency distribution, the 20-yr flood was estimated to be 8,700 cfs. (Knapp-USGS)
W70-05163

WATER RESOURCES OF THE YELLOW MEDICINE RIVER WATERSHED, SOUTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
R. P. Novitzki, W. A. Van Voast, and L. A. Jerabek.
Geological Survey Hydrologic Investigations Atlas HA-320, 3 sheet, 1969. Text, 27 fig, 6 tab, 6 ref.

Descriptors: *Water resources, *Minnesota, Groundwater, Surface waters, Water resources development, Water supply, Water yield, Lakes, Streams, Aquifers, Recreation, Hunting, Fishing, Trapping.
Identifiers: Yellow Medicine River (Minn).

The water resources of the Yellow Medicine River Watershed, Minnesota are described in a 3-sheet Hydrological Atlas consisting of geological cross sections, block diagrams, small-scale maps, summary data tables, hydrographs, and duration curves. Lakes are shallow and best suited for hunting and trapping. Groundwater yield is sufficient for present and projected needs. Surface water use is less than 1% of annual flow, indicating a large potential development. (Knapp-USGS)
W70-05168

FLOOD PLAIN INFORMATION - CANYON CREEK AT JOHN DAY AND CANYON CITY, OREGON.
Corps of Engineers, Walla Walla, Wash.
For primary bibliographic entry see Field 04A.
W70-05171

FLOOD PLAIN INFORMATION, CUYAHOGA RIVER, CUYAHOGA AND SUMMIT COUNTIES, OHIO.
Corps of Engineers, Buffalo, N.Y.
For primary bibliographic entry see Field 04A.
W70-05172

ON THE EFFECTS OF SUSPENDED SEDIMENTS TO THE BED ROUGHNESS,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-05188

MACROTURBULENT FLOW IN STEEP OPEN CHANNELS WITH HIGH NATURAL ROUGHNESS,
For primary bibliographic entry see Field 08B.
W70-05189

A STUDY OF THE ROUGHNESS OF CONCEPTUAL RIVER SYSTEMS OR WATERSHEDS,
Missouri Univ., Rolla. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W70-05190

UNIFORM FLOW IN IDEALIZED CHANNEL-FLOOD PLAIN GEOMETRIES,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05191

BOTTOM SHEAR MEASUREMENT IN AN OPEN CHANNEL FLOW,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
For primary bibliographic entry see Field 02J.
W70-05193

EXPERIMENTAL STUDY OF FLUME-BED ROUGHNESS,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02J.
W70-05194

THE EFFECT OF SAND RIPPLES ON THE INCREASE OF RIVER BED ROUGHNESS,
Hydraulic Research Inst., Prague (Czechoslovakia). Dept. of Hydraulics and Hydrology.
For primary bibliographic entry see Field 02J.
W70-05195

OBSERVED FORMS OF BED ROUGHNESS IN AN UNSTABLE GRAVEL RIVER,
Research Council of Alberta, Edmonton.
V. J. Galay.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A11, p 85-94, 1967. 10 p, 6 fig, 2 tab, 7 ref.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Sounding, *Aerial photography, Rivers, Bed load, Dunes, Gravels, Sands, Particle size, Turbulent flow, Discharge (Water), Channel morphology.
Identifiers: *Canada, Alberta, North Saskatchewan River.

Echo-sounder measurements on an unstable gravel river in Alberta, Canada, indicate that minor bed forms develop on the river bed during high flow conditions and high bed-load transport. The wavelength of these bed forms appears to decrease with an increase in flow intensity and depth, for relatively small values of depth to grain size. Air photographs of this river reveal that the major bed forms (bars) are crescent-shaped with horns pointing downstream. (Knapp-USGS)
W70-05196

DETERMINATION OF ROUGHNESS COEFFICIENTS FOR VERY IRREGULAR RIVERS WITH LARGE FLOODPLAINS,
Institute for Water Resources, Belgrade (Yugoslavia).
Stevan Bruk, and Zvonimur Volf.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A12, p 95-99, 1967. 5 p, 3 fig.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Flood plains, *Vegetation effects, Mannings equation, Regression analysis, Channel morphology, Model studies, Hydraulic models.
Identifiers: Yugoslavia, Tamish River.

The channel geometry, total discharge and slope are known along a reach of the Tamish River, Yugoslavia, a very irregular river with a large floodplain. The reach is divided into sections, and each section is subdivided into main channel and several strips of the floodplain covered by definite types of vegetation. The sum of partial discharges for each strip, expressed by the Manning equation, equals the total discharge for each section. The only unknown variables of the equations are the roughness coefficients, corresponding to the main channel and to the types of vegetation on the floodplains. As the number of equations greatly exceeds the number of unknown variables, the method of least squares can be applied to obtain the most reliable values of the roughness coefficient, taking into consideration that the total loss of head between the first and last section of the reach must be equal to its measured value. Roughness coefficients for floodplains under grass, planted trees and natural forest were determined by means of computer calculations. (Knapp-USGS)
W70-05197

COLUMBIA RIVER BED FORMS,
Washington Univ., Seattle. Dept. of Geology; and Washington Univ., Seattle. Dept. of Oceanography.
John T. Whetten, and Timothy J. Fullam.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A14, p 107-114, 1967. 8 p, 7 fig, 1 tab, 4 ref. NSF Grant GP-3591; AEC Contract No AT (45-1)-1725 (RLO-1725-93).

Descriptors: *Channel morphology, *Roughness (Hydraulic), *Sand waves, *Columbia River, Currents (Water), Winds, Waves (Water), Bed load, Sediment transport, Sounding, Surveys, Alluvial channels.
'dentifiers: Seismic profiler.

Large sand waves on the bed of the lower Columbia River have been examined with a seismic profiler. The sand waves vary in size and shape; the largest are up to 200 m long and 5.5 m high. In Bonneville Reservoir, sand waves migrated downstream at a rate of 0.7 m/day during high water discharge in 1966 when bottom current velocities were 50-60 cm/sec. The rate of forward movement decreased with decreasing discharge. Some sand waves are subaerially exposed at low discharges of the river, and are modified by the wind. In areas where wind direction is nearly the same as water current direction, the wind-modified sand waves tend to be elongated and flattened. (Knapp-USGS)
W70-05198

RECOGNITION OF SCOUR OF RIVER CHANNEL FOR DESIGN PURPOSES,
Corps of Engineers, Kansas City, Mo.
For primary bibliographic entry see Field 08B.
W70-05199

EFFECT OF BEDLOAD MOVEMENT ON THE ROUGHNESS COEFFICIENT VALUE,
Hydraulic Research Inst., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 02J.
W70-05200

ABOUT THE ROUGHNESS IN ALLUVIAL CHANNELS WITH COMPARATIVELY COARSE BED MATERIALS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 02J.
W70-05201

SOME EXPERIMENTAL OBSERVATIONS ON FREE SURFACE SHEAR FLOW OVER A WAVY BOUNDARY,
Ecole Polytechnique, Montreal (Quebec); and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-05202

RESISTANCE TO FLOW IN FIXED-BED CHANNELS WITH THE INFLUENCE OF CROSS-SECTIONAL SHAPE AND FREE SURFACE,
Genoa Univ. (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05203

THE ANALYSIS AND ESTIMATES OF ENERGY LOSSES BY INSTANTANEOUS VELOCITY DISTRIBUTION OF STREAMS WITH MOVABLE BED,
State Hydrological Inst., Leningrad (USSR).
N. S. Znamenskaya.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A4, p 27-31, 1967. 5 p, 3 fig, 7 ref.

Descriptors: *Sediment transport, *Bed load, *Turbulent flow, Regime, Dunes, Roughness (Hydraulic), Model studies, Mathematical models, Hydraulic models.
Identifiers: Bed load (Kinematic structure), Movable-bed channels.

The kinematic structure of turbulent streams with movable beds is discussed. Analysis of the velocity distribution images for dunes of different forms yielded energy losses and the necessary empirical relationships to characterize eddy formations and turbulence parameters. Energy losses were determined from Stock's formula of energy dissipation rate. Empirical relationships were used for hydrodynamic estimation of energy losses. Energy losses were determined by the proposed method and the results were compared with energy losses obtained from stream slope. The results of comparison are satisfactory and confirm the method. (Knapp-USGS)
W70-05204

INDUCTIVE APPROACH TO PHASES OF MOBILE-BED ROUGHNESS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
T. Blench.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967. Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A3, p 18-26, 1967. 9 p, 4 fig, 13 ref.

Descriptors: *Bed load, *Sediment transport, *Turbulent flow, Mathematical models, Parametric hydrology, Regime, Dimensional analysis, Model studies, Hydraulic models, Roughness (Hydraulic).
Identifiers: Bed load models (Conceptual).

The status of 'evolution of the river bed' and 'sediment transport' in the IHD Program is discussed. A major weakness in the combined topics is seen to be the gross discordance among competitive bed-load transport formulas, which are flow formulas expressed with the bed-load transport explicit in the roughness factor. Discordance are believed to arise from reliance on deduction from speculative premises to the exclusion of physical considerations. An inductive attack on the formula problem is outlined, with explanations. An orientation of research is proposed to suit. (Knapp-USGS)
W70-05205

STATISTICAL ANALYSIS AS A FLOOD ROUTING TOOL,
Weather Bureau, Salt Lake City, Utah. Western Region.
Robert J. C. Burnash.
Available from the Clearinghouse as PB-188 744, $3.00 in paper copy, $0.65 in microfiche. Technical memo., WBTM-WR-47, Dec 69, 12 p.

Descriptors: *Floods, *Flood routing, *Statistical methods, Flood plains, Drainage, Storage, *Hydrographs.
Identifiers: Conecuh River, California.

The use of statistics as an aid to flood routing analysis is referred to by Linsley, Kohler and Paulus. It is pointed out that coefficients of the Muskingum flood routing technique can be derived statistically. Requirements of their equation are given. This requirement precludes use of any parameters which are not linear for such parameters cannot maintain volumetric continuity except at a single level discharge.
W70-05316

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 07C.
W70-05464

CELL METHOD FOR COMPUTING LAKE CIRCULATION,
Cornell Univ., Ithaca, N.Y. School of Civil Engineering.
For primary bibliographic entry see Field 02H.
W70-05482

RESISTANCE TO FLOW OVER TWO-DIMENSIONAL STRIP ROUGHNESS,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05483

DYNAMIC EQUATIONS FOR STEADY SPATIALLY VARIED FLOW,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05484

AVERAGE FLOW OF MAJOR STREAMS IN FLORIDA,
Geological Survey, Tallahassee, Fla.
W. E. Kenner, E. R. Hampton, and C. S. Conover.
Florida Bureau of Geology Map Series No 34, 1969. Text, 1 map.

Descriptors: *Streamflow, *Florida, Mapping, Discharge (Water), Rivers, Streams, Lakes, Canals, Data collections, Hydrologic data.
Identifiers: Florida streamflow.

In Florida a major stream as used in this study is one that has an average flow of at least 1,000 cfs. Based on estimated flows at mouths or outlets, Florida has 11 major streams. In general, the drainage basins in northern Florida are large compared with those in southern Florida; topographic relief is greater, evaporation rate is lower, lakes are fewer, and the land is developed to a lesser degree. In general, therefore, average flow of streams in northern Florida is greater than that for streams in southern Florida. Four of Florida's five largest streams are in northern Florida. They are the Apalachicola, Suwannee, Choctawhatchee, and Escambia Rivers. The third largest stream, the St. Johns River, drains both southern and northern Florida. Except for the St. Johns River, all five of the largest rivers derive flow from beyond the borders of Florida. At the Florida line the average flow of the Apalachicola River is 22,000 cfs, or about 14,000 mgd. In southern Florida, streams for the most part are poorly developed and most of the drainage is through a system of canals. (Knapp-USGS)
W70-05486

BASIC DATA FOR URBAN HYDROLOGY STUDY, DALLAS, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 80 p, 3 fig, 1 tab, 6 ref, append.

Descriptors: *Floods, *Hydrologic data, *Data collections, *Texas, *Urbanization, Rainfall-runoff relationships, Runoff, Streamflow, Hydrographs, Storm runoff.
Identifiers: *Dallas (Texas), *Urban hydrology.

This report presents the basic hydrologic data collected during the 1967 water year (October 1, 1966, to September 30, 1967). Basic data were collected for urban hydrology studies to determine, on the basis of historical data and hydrologic analyses, the magnitude, frequency, and areal extent of flooding, to document and define floods of greater than ordinary magnitude, and to determine the effect of urban development on flood peaks and volume on small streams in Dallas, Texas. (Knapp-USGS)
W70-05500

COMPILATION OF HYDROLOGIC DATA, MUKEWATER CREEK, COLORADO RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 87 p, 2 fig, 3 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Mukewater Creek (Tex), Colorado River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 70.0-square-mile area above the stream-gaging station on Mukewater Creek at Trickham, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to develop computation techniques that will provide more accurate estimates of runoff, to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures, to determine the minimum instrumentation necessary to make reliable estimates of total storm inflow to the structures, and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05501

COMPILATION OF HYDROLOGIC DATA, PIN OAK CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 25 p, 2 fig, 5 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Pin Oak Creek (Tex), Trinity River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 17.6-square-mile area above the stream-gaging station in Pin Oak Creek near Hubbard, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to determine the effect of the structures on the sediment yield of the basin and to determine the trap efficiency of the structures, to develop computation techniques that will provide more accurate estimates of runoff, to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures, to determine the minimum instrumentation necessary to make reliable estimates of total storm inflow to the structures, and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05502

COMPILATION OF HYDROLOGIC DATA, NORTH CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 27 p, 2 fig, 2 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: North Creek (Tex), Trinity River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 21.6-square-mile area above the stream-gaging station North Creek near Jackson, Texas. The location of proposed floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to develop computation techniques that will provide more accurate estimates of runoff resulting from a given amount of rainfall, to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures, to check the applicability of flood-routing procedures and techniques for small watersheds, and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05503

COMPILATION OF HYDROLOGIC DATA, GREEN CREEK, BRAZOS RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 34 p, 2 fig, 3 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Green Creek (Tex), Brazos River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 46.1-square-mile area above the stream-gaging station Green Creek near Alexander, Texas. The locations of floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to develop computation techniques that will provide more accurate estimates of runoff resulting from a given amount of rainfall on small watersheds, and to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures. (Knapp-USGS)
W70-05504

COMPILATION OF HYDROLOGIC DATA, HONEY CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 68 p, 2 fig, 3 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Honey Creek (Tex), Trinity River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 39.0-square-mile area above the stream-gaging station Honey Creek near McKinney, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on maps. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow, to determine the effect of the structures on the sediment yield of the basin and to determine the trap efficiency of the structures, to develop computation techniques that will provide more accurate estimates of runoff, to develop relationships between maximum rates of runoff and rainfall to enable more accurate design of small storm-drainage structures, to determine the minimum instrumentation necessary and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05505

BASE-FLOW-RECESSION CURVES,
C. Toebes, W. B. Morrissey, R. Shorter, and M. Hendy.
New Zealand Handbook of Hydrological Procedures, Procedure No 8, Ministry of Works, Wellington, 1969. 8 p, 8 fig, 4 ref.

Descriptors: *Base flow, *Recession curves, Analytical techniques, Hydrographs, Streamflow forecasting, Hydrogeology, Runoff, Groundwater movement, Low flow, Surface-groundwater relationships, Hydrograph analysis.
Identifiers: Base-flow recession curves.

The uses and interpretation of base-flow recession curves in forecasting streamflow are briefly discussed. The base-flow recession curve is the lower part of the falling limb of a hydrograph and expresses the relation between base flow and time. Since base flow is largely groundwater effluent, the base-flow recession curve represents mainly withdrawal from groundwater storage. However--depending on the water-table level, the river-bank material, the soils in the neighborhood of the river bank, and the rates of rise and fall of the stream--withdrawal from bank storage will contribute to base flow. Several curves have been suggested as representing base-flow recession. The most important of these are: simple exponential, double exponential, and hyperbolic. In conditions where ice melt contributes to the base flow, the ice-melt exponential and the ice-melt hyperbola can be used. (Knapp-USGS)
W70-05507

FLOODS IN MARENGO SOUTH QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Oak Park, Ill.
Howard E. Allen.
Geological Survey Open-file report, October 1969. 9 p, 15 fig, 1 plate, 1 ref.

Descriptors: *Floods, *Illinois, Profiles, Maps, Data collections, Hydrologic data, Stage-discharge relations, Frequency analysis, Discharge (Water).
Identifiers: Marengo (Ill).

Hydrologic data are presented to be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Marengo South quadrangle, northeastern Illinois. The areas inundated by floods are delineated on a topographic map. Local residents reported that the flood of August 1968 was the highest observed in the last 20 years. The general procedure used in defining the flood boundaries was to construct flood profiles from elevations of floodmarks identified in the field and from data available from other agencies. There are several depressions and lowland areas where surface water accumulates because of inadequate drainage into the streams. Frequency and depth of flooding in these areas are unrelated to the water-surface elevation along the streams. (Knapp-USGS)
W70-05510

COMPILATION OF HYDROLOGIC DATA, MOUNTAIN CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 9 p, 1 fig, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collection, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Mountain Creek (Tex), Trinity River basin (Tex).

Collection of hydrologic data by the U.S. Geological Survey in the Mountain Creek watershed, Texas began March 9, 1925, with the establishment of a stream-gaging station about 2-1/2 miles upstream from the present site of Mountain Creek Lake Dam. The stream-gaging station was discontinued July 5, 1933. The purpose of this report is to compile under one cover the basic data collected annually in the Mountain Creek watershed. This report covers the 1967 water year. More than 90% of the watershed is in farms and about 6 percent is in urban areas. The topography ranges from steep rock covered hills along the east edge of the watershed to gently rolling hills in the central and western parts. Elevations range from 870 feet in the Cedar Hill area to about 415 feet in the bottoms near Grand Prairie. The long-term mean annual rainfall for the watershed is about 34 inches. Individual rains may cause serious flooding in any season, but occur most frequently in the spring. (Knapp-USGS)
W70-05511

DIFFUSION BELOW SUBMERGED RECTANGULAR OUTLETS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05512

FLOW PHENOMENA NEAR ROUGH BOUNDARIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-05517

FLOOD PLAIN INFORMATION, JORDAN RIVER COMPLEX, SALT LAKE CITY, UTAH.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-05518

FLOOD PLAIN INFORMATION, POESTA CREEK AND SALT CREEK, BEEVILLE, TEXAS.
Corps of Engineers, Galveston, Tex.
For primary bibliographic entry see Field 04A.
W70-05519

FLOOD CONTROL CHANNEL HYDRAULICS,
Corps of Engineers, Los Angeles, Calif. Hydraulics Section.
For primary bibliographic entry see Field 08B.
W70-05523

A THEORY OF STABILITY OF STREAMS,
Nagoya Univ. (Japan). Dept. of Civil Engineering.
Shohei Adachi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A42, p 338-344, 1967. 7 p, 2 fig.

Descriptors: *Alluvial channels, *Meanders, *Mathematical models, Channel morphology, Roughness (Hydraulic), Fluid friction, Turbulent flow, Steady flow, Unsteady flow.
Identifiers: Channel stability.

Stability of streams is treated theoretically by using the small amplitude oscillation theorem to find flow factors contributing to the origin of meandering. In

order to express the lateral variations of stream, flow depth parameters are introduced into the basic equations. By assuming that any disturbance may be superposed on the stationary flow, the stability equation for the lateral variations is formulated. Although the complete solution has not been found, the conditions of the neutral disturbance have been obtained. (Knapp-USGS)
W70-05524

THE BED FORM ON RECTILINEAR AND CURVILINEAR RIVER AND BIG CHANNEL SECTIONS,
Yu. A. Ibad-Zade, and T. N. Kiyasbeili.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A43, p 345-353, 1967. 9 p, 7 fig, 6 ref.

Descriptors: *Channel morphology, *Alluvial channels, Mathematical models, Channel erosion, Open channel flow, Sediment transport, Shape, Meanders.
Identifiers: River bed form.

Continuous interaction between fluid and solid media and natural deformation processes of river beds determine the origin and development of the characteristic bed forms. To use natural processes to form channels, channel deformation processes must be understood. Analytical research with the application of classic methods of the calculus of variations permit calculation of the hydraulic flow elements and the discharge of water passing over beds of given form. Comparison with natural data shows reasonable results. (Knapp-USGS)
W70-05525

ON A SOLUTION OF BED FLUCTUATION IN OPEN CHANNEL WITH MOVABLE BED OF STEEP SLOPE,
Kobe Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05526

ON THE VELOCITY COEFFICIENT AND HYDRAULIC ROUGHNESS IN MEANDERING WATERCOURSES,
Research Inst. for Water Resources Development, Budapest (Hungary). Dept. for Hydromechanics.
Oliver Gyorke.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A40, p 324-329, 1967. 6 p, 3 fig, 1 ref.

Descriptors: *Hydraulics, *Alluvial channels, *Roughness (Hydraulic), Sediment transport, Particle size, Particle shape, Mannings equation, Chezy equation, Streamflow, Turbulent flow, Open channel flow, Meanders.
Identifiers: Meandering channels.

Changes in Chezy's velocity coefficient and absolute roughness in a meandering stream were determined on the basis of stages pertaining to several known rates of flow in several typical cross sections in the apex of the bend, at the point of counterflexure and along an approximately straight reach. Differences were found to exist between the values derived from these observation data and those calculated with the characteristic particle diameter of bed material, using the modified Manning-Strickler equation. In this connection the influence of currents in bends on hydraulic roughness is demonstrated. (Knapp-USGS)
W70-05527

THE KINETIC ENERGY CORRECTION FACTOR AND THE MOMENTUM CORRECTION FACTOR IN OPEN CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05528

CALCULATION PROCESS OF POLYGONAL CROSS-SECTION CANALS (FRENCH),
Youlouse Univ. (France). Institut de Mecanique des Fluides.
For primary bibliographic entry see Field 08B.
W70-05529

A RECONSIDERATION OF THE HYDRAULIC RADIUS AS A GEOMETRIC QUANTITY IN OPEN CHANNEL HYDRAULICS,
Alabama Univ., Huntsville. Dept. of Fluid Mechanics; and Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 08B.
W70-05530

THE GRADUALLY VARIED FLOW IN NONPRISMATIC CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05531

EXPERIMENTS FOR THE VERIFICATION OF THE PASSAGE THEORY,
Research Inst. for Water Resources Development, Budapest (Hungary).
Zoltan Szigyarto.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A31, p 249-256, 1967. 8 p, 1 fig, 2 ref.

Descriptors: *Hydrograph analysis, *Streamflow forecasting, *Discharge (Water), Gaging stations, Infiltration, Surface-groundwater relationships, Routing.
Identifiers: Hungary.

In many practical hydraulics problems encountered it is necessary to calculate the hydrograph of a downstream section from the known hydrograph of an upstream section and hydraulic properties of the intermediate channel. For the fast and reliable solution of this problem the passage theory was developed. Detailed experiments performed during 1965 for the verification of this theory are described. The theory remains suitable for the reliable transformation of discharge hydrographs even if, in contrast with the fundamental assumption made during the derivation of the theory, the bed is pervious. (Knapp-USGS)
W70-05532

HYDRAULIC SOLUTION AND DEFINITION OF THE UNSTABILITY CRITERION OF STREAM WANDERING WITHIN BED, AND VORTEX ZONES,
Kharkov Vodokanalniiproekt Inst. (USSR). Hydraulic Engineering Lab.
I. A. Sherenkov.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A30, p 240-248, 1967. 9 p, 4 fig, 10 ref.

Descriptors: *Meanders, *Alluvial channels, *Channel morphology, *Bank stability, Bank stabilization, Turbulent flow, Erosion, Scour, Bed load, Discharge (Water), Sediment discharge, Stream stabilization.
Identifiers: USSR, Stream channel stability.

A new method of calculation of a flow expanding within its bed with the creation of lateral vortexes is described. The flow is divided into a direct flow, to which a transitory stream and a forward flow of vortex are included, and a zone of reversal flow, which is the return branch of the vortex flow. The interaction between these areas is manifested by changes of the rate of discharge along the way, as well as creation of shear stresses on the boundary of the zones. From the equation of momentum and the changes of the discharge rate along the stream, and the equation of continuity, a system of equations for calculation is obtained. To solve the problem of the wandering stream stability, the Liapunov's direct method has been applied, and criterion of stability was obtained. The method of calculation is applicable for computers. (Knapp-USGS)
W70-05533

EFFECTS OF STAGES ON SCOUR ALONG RIVERBANKS,
US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Hydraulics Div.
John J. Franco.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A29, p 232-239, 1967. 8 p, 3 fig.

Descriptors: *Stage-discharge relations, *Scour, *Erosion, *Mississippi River, Hydraulics, Sediment transport, Bed load, Discharge (Water), Streamflow, River training, Flood protection, Bank stability, Bank stabilization, Stream stabilization.
Identifiers: *Stage-scour relations.

Periodic surveys were made along several reaches of the Mississippi River through one high-water season to determine the effects of changes in river stages on depth of scour along concave riverbanks. The results have shown that scour or deposition can occur along riverbanks depending on the alignment and configuration of the channel upstream and downstream and river stages. In general, the depth of scour increases with increase in river stage but the alignment of the channel can be such that deposition occurs with rising stages. Also, the location of the point of maximum scour or deposition can change with change in stage. These results indicate how regulating and stabilizing structures can be affected by the change in stage. In rivers where the rate of change of stages is moderate, the depth of scour or deposition is more a function of the actual stage (elevation) and stage duration than of the rate of change. (Knapp-USGS)
W70-05534

THE SIMILARITY IN FLOWS AT STRAIGHT REACHES OF RIVERS,
Leningrad Inst. of Water Transport (USSR).
K. V. Grishanin.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A28, p 226-231, 1967. 6 p, 2 fig, 2 tab, 2 ref.

Descriptors: *Stage-discharge relations, *Alluvial channels, *Rivers, Hydraulics, Open channel flow, Streamflow, Streamflow forecasting, Equations, Hydraulic similitude.
Identifiers: *USSR, *Rating curves.

A hypothesis is proposed concerning the relation between the geometric similarity of river channels and dynamic similarity of river flows. Measurements made at the rivers in the plains of the USSR confirm the hypothesis well. As a result of considerations, a universal rating curve, approximately valid for river straight reaches of arbitrary width and depth is plotted. By the aid of this curve it is possible to determine the rough value of a water discharge in the absence of information about the channel resistance and the water surface slope. (Knapp-USGS)
W70-05535

METHODS AND DEVICES FOR MEASURING CURRENTS,
Marine Advisers, La Jolla, Calif.
For primary bibliographic entry see Field 07B.
W70-05543

2F. Groundwater

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE UPPER FREMONT RIVER VALLEY, WAYNE COUNTY, UTAH,
Geological Survey, Logan, Utah.
L. J. Bjorklund.
Copies of report available at Utah Dept of Natural Resources, Div of Water Rights, 442 State Capitol, Salt Lake City, Utah. Technical Publication No 22, 1969. 54 p, 11 fig, 6 tab, 21 ref.

Descriptors: *Water resources, *Groundwater, *Utah, Aquifers, Water wells, Artesian wells, Water supply, Water quality, Data collections, Hydrologic data, Hydrogeology, Alluvium, Springs, Water yield.
Identifiers: Fremont River valley (Utah).

The upper Fremont River valley, a depression caused by faulting, altered by erosion, and partly filled by alluvium eroded from surrounding highlands, includes about 40 square miles in south-central Utah. The drainage basin which contributes water to the valley includes about 700 square miles. Water drains to the valley from several high plateaus. Sedimentary rocks of Triassic, Jurassic, Tertiary, and Quaternary age and volcanic rocks of Tertiary age are exposed in the area. The Tertiary volcanic rocks yield water to several large springs and flowing wells; this unit is the principal source of groundwater in the valley. The valley fill of Quaternary age, which is more than 500 feet thick in places, is also an important source, yielding water to many wells. The average annual inflow to the valley via the Fremont River during 1950-57 was 29,120 acre-feet and the average annual outflow during 1909-57 was 64,840 acre-feet. About 80,000 acre-feet of water is discharged by springs and seeps in the valley during most years. Approximately 3,500 acre-feet of water is discharged from flowing wells and about 700 acre-feet is pumped from wells during a year. Irrigation is the principal use of both surface and groundwater in the valley. Groundwater is used also for the public supplies of Fremont, Loa, Lyman, and Bicknell, for domestic and stock use, and for fish culture. The groundwater in the valley is suitable for most uses. (Knapp-USGS)
W70-05071

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER -- PHASE I,
Kansas Water Resources Research Inst., Manhattan.
Don W. Green, and Ronald L. Cox.
Available from the Clearinghouse as PB-190 481, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Kansas Water, Water Resources Institute Contribution No. 3, (September, 1966). 107 p, 28 ref, 4 append. OWRR Project B-003-KAN.

Descriptors: *Digital computers, *Mathematical models, *Underground reservoirs, *Saline waters, *Fresh water, Underground storage, Aquifers, Recharge, Porous media, Permeability, Flow.

A computer model has been developed for application to salt water - fresh water displacement processes in porous media. It is based on the numerical method of characteristics as presented by Garder, Peaceman, and Pozzi. The model is two-dimensional, allows for dispersion of mixing of the fluid-fluid interface, and accounts for fluid density differences. Porous-media properties are held constant. The details of the computer program including a listing are included in this report. Several calculations were made with the model approximating laboratory-scale displacement experiments and an actual field underground fresh-water storage test. These calculations indicate the potential usefulness of the mathematical model.
W70-05116

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER-PHASE II,
Kansas Water Resources Research Inst., Manhattan.
Don W. Green, Ronald Cox, and Craig Bate.
Available from the Clearinghouse as PB-190 482, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Kansas Water Resources Research Institute Contribution Number 36, 1970. 187 p, 16 tab, 45 fig, 43 ref, 2 append. OWRR Project B-008-KAN.

Descriptors: *Digital computers, *Mathematical models, *Underground reservoirs, *Saline water, *Fresh water, Underground storage, Aquifers, Recharge, Porous media, Permeability, Flow.

A digital computer model has been developed to solve numerically the partial differential equations describing liquid-liquid miscible displacement in two-space dimensions in porous media. The model is based on the method of characteristics solution previously described in the literature. The model presented here was first described in a project completion report covering Phase I of this work. A laboratory experimental system that is a physical analog of the mathematical model was designed and constructed. Experimental miscible displacements were conducted in which water of one salt concentration displaced water of a different salt concentration. Concentrations were measured insitu in the porous media as a function of time and position by using conductivity cells wired to a multi-point recorder. Concentration differences between the two solutions were varied in different runs in order to alter the amount of gravity segregation. Other experiments were conducted in which the porous-media system was composed of two layers of different size glass beads and, therefore, different permeabilities. The experimental displacements were simulated with the computer model. The model, in general, did a good job of predicting the behavior of the liquid-liquid interfacial concentration zone.
W70-05117

EFFECTS OF BANK SEEPAGE ON FLOOD HYDROGRAPHS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02A.
W70-05126

BORON IN GROUNDWATERS OF THE CRETACEOUS OF THE WEST CAUCASUS FORELAND,
Voronezh State Univ. (USSR).
For primary bibliographic entry see Field 02K.
W70-05137

NONSTEADY FLOW TO SURFACE RESERVOIR,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. Wen-Gong Yeh.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7137, pp 609-618, March 1970. 10 p, 6 fig, 2 tab, 16 ref, append.

Descriptors: *Bank storage, *Unsteady flow, *Groundwater movement, *Aquifers, *Mathematical studies, Drawdown, Mathematical models, Computers, Equations, Dimensional analysis, Base flow, Water table, Water level fluctuations, Surface-groundwater relationships, Water yield.
Identifiers: Bank storage yield.

When groundwater flows from an unconfined aquifer to a surface reservoir the position of the water table will change with time. The nonlinear partial differential equation for water table elevation is transformed to a nonlinear ordinary differential equation by similarity substitution and a numerical procedure for its solution is presented. A method of computing bank storage is presented. The solution compares favorably with the experimental results obtained by others. (Knapp-USGS)
W70-05158

EXACT FLOW RATES FROM DUPUIT'S APPROXIMATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
Bruce W. Hunt.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7140, p 633-642, March 1970. 10 p, 5 fig, 7 ref, append.

Descriptors: *Groundwater movement, *Dupuit-Forchheimer theory, Seepage, Aquifers, Water table, Water level fluctuations, Equations, Permeability, Porous media.
Identifiers: Aquifer leakage.

Certain problems in three-dimensional, confined and unconfined, groundwater seepage are reduced to two-dimensional boundary-value problems by integrating the exact equations of motion in the vertical direction. It is shown that the solution of these two-dimensional boundary-value problems gives exact flow rates, and that these flow rates are identical to those obtained from the classical Dupuit theory of groundwater motion. It is also concluded that free surface coordinates and piezometric head distributions are not, in general, given exactly by the Dupuit formulation. (Knapp-USGS)
W70-05162

TECHNIQUES FOR THE TRACING OF SUBTERRANEAN DRAINAGE,
David P. Drew, and David I. Smith.
British Geomorphological Research Group Technical Bulletin No 2, 1969. 36 p, 5 fig, 2 tab, 45 ref.

Descriptors: *Tracers, *Tracking techniques, *Subsurface drainage, *Groundwater movement, *Karst, Radioactivity techniques, Spores, Clubmoss, Dye releases, Drainage systems, Drainage patterns (Geologic), Geomorphology.
Identifiers: Underground drainage tracing.

Methods for tracing groundwater movement, particularly in karst systems, are discussed. An annotated bibliography is included. The choice of tracing method will depend on a large number of factors. Major factors are expense on both capital equipment and the tracer itself, the time available, and the problem of toxicity. For tests of streams of small discharge over relatively short distances the dye methods are often suitable. Their major handicap for detailed studies is that if the dilution is large it may be beyond the limits of detection. For reconnaissance studies particularly in regions remote from laboratory facilities rhodamine B or malachite green are preferable to fluorescein as, under field conditions, fluorescein can often become rapidly bleached. For detailed work yielding additional information on flow times the Lycopodium spore method is the best tracer available. For the tracing of percolation water the only simple method is that employing pyranine concentrate. The alternative of using radioactive tracers is expensive and usually prohibited by authorities controlling water supplies. (Knapp-USGS)
W70-05166

WATER RESOURCES OF THE YELLOW MEDICINE RIVER WATERSHED, SOUTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-05168

AVAILABILITY OF GROUNDWATER FOR LARGE-SCALE USE IN THE MALAD VALLEY-BEAR RIVER AREAS OF SOUTHEASTERN IDAHO--AN INITIAL ASSESSMENT,
Geological Survey, Boise, Idaho. Water Resources Div.
W. L. Burnham, A. H. Harder, and N. P. Dion.

Geological Survey Open-file Report, 1969. 40 p, 7 fig, 2 tab, 5 ref.

Descriptors: *Water resources, *Idaho, *Groundwater, Aquifers, Water yield, Water resources development, Irrigation water, Water wells, Alluvium, Water supply, Water levels, Artesian wells.
Identifiers: Malad Valley (Idaho), Bear River (Idaho).

Parts of the Bear River drainage of southeastern Idaho offer potential for further development of groundwater -- the valley north of Bear Lake, north of Soda Springs, Gem Valley, Cache Valley in Idaho, and Malad Valley in Idaho. Malad Valley contains a large aquifer system in valley fill underlying about 75 square miles. The aquifer system is several hundred feet thick, and contains about 1.8 million acre-feet of water in storage in the top 300 feet of saturated thickness. Average annual recharge to the valley-fill aquifer is about 64,000 acre-feet. Lowering of the water level 100 feet uniformly over the valley area would theoretically yield about 300,000 acre-feet from storage and salvage a present-day large nonbeneficial discharge. Chemical-quality problems in Malad Valley seem not to be sufficient to prohibit development and use of the groundwater resource. (Knapp-USGS)
W70-05169

SUBSURFACE DISPOSAL OF INDUSTRIAL WASTES,
Michigan State Geological Survey, Lansing.
For primary bibliographic entry see Field 05E.
W70-05181

DATA FOR SPRINGS IN THE NORTHERN COAST RANGES AND KLAMATH MOUNTAINS OF CALIFORNIA,
Geological Survey, Menlo Park, Calif.
C. F. Berkstresser, Jr.
Geological Survey Open-file report, 1968. 49 p, 1 fig, 159 ref, 2 append.

Descriptors: *Springs, *California, Groundwater, Hydrogeology, Hydrologic data, Data collections, Aquifers, Water quality, Water chemistry, Water yield, Water supply.
Identifiers: Klamath Mountains (Calif), Coast Ranges (Calif).

Basic data are provided about selected springs in the Coast Ranges and Klamath Mountains north of San Francisco, California. Criteria used to select springs included accessibility, availability of previous data, and geologic or hydrologic significance. Temperature and pH were measured at the spring site and ammonium was determined qualitatively. Flow was measured or estimated, depending on the situation at each site. The location of each site was determined on topographic or other available maps. Chemical and spectrographic analyses include most of the major, minor, and trace inorganic constituents that occur in natural water. The bibliography includes references to springs, groundwater flow, geochemistry, hydrothermal waters, California groundwater resources, California geology, California mineral waters, California mineral resources, and water chemistry. (Knapp-USGS)
W70-05182

GROUNDWATER FLOW SYSTEMS AND RELATED HIGHWAY PAVEMENT FAILURE IN COLD MOUNTAIN VALLEYS,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 04C.
W70-05184

GROUNDWATER SUPPLY OF CAPE HATTERAS NATIONAL SEASHORE RECREATIONAL AREA, NORTH CAROLINA - PART 4,
Geological Survey, Raleigh, N.C.
Orville B. Lloyd, Jr., and Hugh B. Wilder.
North Carolina Department of Water Resources Report of Investigations No 5, 1968. 19 p, 5 fig, 3 tab, 3 ref.

Descriptors: *Water supply, *Groundwater, *National seashores, *North Carolina, Aquifers, Geology, Sands, Water wells, Water yield, Water quality, Hydrologic data.
Identifiers: Cape Hatteras National Seashore.

In the spring of 1963, the Park Service requested the U.S. Geological Survey to determine whether or not adequate groundwater could be obtained in the vicinity of Fort Raleigh National Historical Site, Cape Hatteras, to supply park headquarters, other administrative buildings, and ranger homes. In general, the rock material that underlies the area of study consists largely of sand that was deposited in a marine environment. Four units of sand, silt, and clay underlie the Fort Raleigh area to depths of about 157 ft below land surface. The moderately coarse sand unit between approximately 18 and 44 ft below land surface is the best aquifer in which to develop future groundwater supplies in the area. Two-inch diameter wells spaced no less than 180 ft apart and tapping the full thickness of the aquifer between approximately 18 and 44 ft will yield 20 gpm each. Future well fields should be located as far from the sounds as possible to decrease the possibility of lateral salt-water encroachment. Water from wells in the area will require treatment to remove hardness-causing constituents and dissolved iron. (Knapp-USGS)
W70-05185

GROUNDWATER SUPPLY OF CAPE HATTERAS NATIONAL SEASHORE RECREATIONAL AREA, NORTH CAROLINA - PART 5,
Geological Survey, Raleigh, N.C.
Granville B. Wyrick, and Roberta B. Dean.
North Carolina Department of Water Resources Report of Investigations No 6, 1968. 29 p, 14 fig, 1 tab, 6 ref.

Descriptors: *Water supply, *Groundwater, *National seashores, *North Carolina, Aquifers, Geology, Sands, Water wells, Water yield, Water quality, Hydrologic data.
Identifiers: Cape Hatteras National Seashore.

The National Park Service requested, in 1965, that the U.S. Geological Survey assist in the design of, and conduct the testing of a lateral well near Try Yard Creek, Ocracoke Island, Cape Hatteras National Seashore Recreational Area, North Carolina. The lateral well method of construction is a practical solution for recovering fresh groundwater in beach areas closely underlain by salt water. The pumping rate should not exceed 20 gpm in order to prevent drawing the water levels down to the well screens. Pumping at 20 gpm should be intermittent to allow sufficient time for natural groundwater flow to flush the upward movement of salt water away from the well. A pumping period of 8 hr in each 24 hr should furnish about 10,000 gpd for the campground without inducing salt water encroachment to the well. The water should be treated for iron, manganese, and hydrogen sulfide, which were the only chemical constituents present in concentrations that would contribute undesirable characteristics to the water. Treatment recommended for the development of a water supply for drinking purposes should include aeration, filtration, and chlorination. (Knapp-USGS)
W70-05186

MODELLING PARTIALLY PENETRATING RIVERS ON AQUIFER MODELS,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-05478

NONINSTRUMENTAL FACTORS AFFECTING MEASUREMENT OF STATIC WATER LEVELS IN DEEPLY BURIED AQUIFERS AND AQUITARDS, NEVADA TEST SITE,
Geological Survey, Las Vegas, Nev.
For primary bibliographic entry see Field 07B.
W70-05479

ELECTRIC WELL LOGGING OF HAWAIIAN BASALTIC AQUIFERS,
Hawaii Univ., Honolulu. Dept. of Geosciences; and Honolulu Board of Water Supply, Hawaii.
For primary bibliographic entry see Field 07B.
W70-05480

ESTIMATING THE GROUND-WATER CONTRIBUTION TO STORM RUNOFF BY THE ELECTRICAL CONDUCTANCE METHOD,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02A.
W70-05481

REGIONAL GROUNDWATER FLOW-OLD WIVES LAKE DRAINAGE BASIN, SASKATCHEWAN,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
R. A. Freeze.
Inland Waters Branch Scientific Series No 5, Canada, Department of Energy, Mines and Resources, 1969. 245 p, 52 fig, 4 plate, 12 tab, 93 ref, 5 append.

Descriptors: *Groundwater movement, *Mathematical models, *Groundwater basins, Digital computers, Computer models, Groundwater discharge, Precipitation (Atmospheric), Runoff, Rainfall-runoff relationships.
Identifiers: Old Wives Lake (Saskatchewan).

The regional groundwater flow system of Old Wives Lake drainage basin, Saskatchewan was studied using field techniques including piezometric analyses, hydrogeochemistry, surficial mapping and low-flow methods. The results were interpreted with the aid of a theoretical approach involving digital computer solutions to mathematical models of groundwater basins. The areas in which two- and three-dimensional mathematical models provided good correlation with the field evidence include a prairie profile environment, a flowing artesian region, a buried valley, a phreatophytic discharge area, and a system of deep 'confined' aquifers. In the Old Wives Lake drainage basin, precipitation varies from 12 to 16 inches per year, potential evapotranspiration from 21 to 24 inches per year, and total runoff from 0.54 to 0.68 inch per year. The average regional groundwater recharge calculated from baseflow interpretation and from moisture budget determinations is in the range 0.10 - 0.20 inch per year. Areally dependent values of groundwater recharge determined from mathematical model results vary from 0.0 to 0.4 inch per year in glacial till to as high as 7.0 inches per year in sand. (Knapp-USGS)
W70-05485

MINERAL AND THERMAL WATERS OF THE WORLD, A-EUROPE.

Georgij Kacura, Editor. Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, 1969. 177 p.

Descriptors: *Thermal water, *Mineral water, Geology, Structural geology, Hydrologic data, Heat flow, Water chemistry, Thermal properties, Trace elements, Water resources, Legal aspects, Mapping, Springs.
Identifiers: Mineral and thermal water seminar.

In January 1966 the 23rd International Geological Congress held a seminar on the 'Genesis of Thermal and Mineral Waters.' Geological conditions, chemical composition of mineral waters, terrestrial

heat flow data, possibilities of the utilization of waters for medical purposes, energy sources, rare elements, and legal protection of water resources were discussed. (See also W70-05488 thru W70-05499). (Gabriel-USGS)
W70-05487

MINERAL AND THERMAL WATERS OF BELGIUM (FRENCH),
J. M. Graulich.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 9-15, 1969. 7 p, 1 fig, 1 tab, 7 ref.

Descriptors: *Mineral water, *Thermal water, *Water chemistry, Aquifers, Groundwater, Salinity, Carbon dioxide, Surface waters, Water temperature, Mapping, Discharge (Water), Carbonates, Springs.
Identifiers: *Belgium.

In general, thermal and mineral water resources of Belgium are rather poor. One of a few natural thermal flows in Chaudfountaine (36 deg), however a few other thermal flows, such as Baudour (53 deg), are located at considerable depths. Mineral waters are mainly of iron and carbonate types containing an abundance of free carbon dioxide such as Spa and Chevron. Water containing more than 1 gram per liter is present at considerable depths in the Gand and Ostende areas. (See W70-05487). (Gabriel-USGS)
W70-05488

THERMAL AND MINERAL WATERS OF CZECHOSLOVAKIA,
G. Kacura, S. Gazda, O. Franko, and J. Silar.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 17-29, 1969. 13 p, 1 fig, 2 tab, 16 ref.

Descriptors: *Thermal water, *Mineral water, *Water chemistry, *Aquifers, *Groundwater, *Springs, Geology, Structural geology, Salinity, Carbon dioxide, Sulfates, Mapping, Water temperature, Chlorides, Carbonates, Heat flow, Boreholes.
Identifiers: *Czechoslovakia.

The Czechoslovak territory abounds in thermal and mineral springs of various types, as a result of diversity of geological conditions. Until present more than 1600 sites of thermal and mineral springs have been recognized with many springs characterized by their high Na, Cl, Fe, bicarbonate, carbon dioxide, Hydrogen sulfide and Mg contents. The most significant mineral waters are utilized for therapeutic purposes. At present there are 37 spas in Czechoslovakia and twenty-five springs are utilized for commercial bottling purposes. (See W70-05487). (Gabriel-USGS)
W70-05489

MINERAL WATERS OF THE GERMAN DEMOCRATIC REPUBLIC (GERMAN),
J. Zieschang.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 59-68, 1969. 10 p, 1 fig.

Descriptors: *Mineral water, *Aquifers, *Water chemistry, *Groundwater, *Springs, Geology, Mapping, Geographical regions, Sulfates, Carbon dioxide, Carbonates, Discharge (Water), Thermal water.
Identifiers: *German Democratic Republic.

The German Democratic Republic has a large number of mineral surface water localities and 3/4 of its territory contains highly mineralized waters at considerable depths; however, the Republic is rather poor in thermal water occurrences. Mineral waters are mainly of sodium-chloride type, but sulfate, carbon dioxide, and bicarbonate waters are also present. The territory of the Republic is subdivided into 6 mineral water provinces whose mineral-water characteristics and geology are described. (See W70-05487). (Gabriel-USGS)
W70-05490

THERMAL, MINERAL, AND THERAPEUTIC WATERS OF HUNGARY (GERMAN),
E. R. Schmidt.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 69-76, 1969. 8 p, 1 fig, 5 ref.

Descriptors: *Thermal water, *Mineral water, *Aquifers, *Springs, *Groundwater, Geothermal studies, Water temperature, Boreholes, Discharge (Water), Mapping, Water chemistry, Carbonates, Calcium, Magnesium, Chlorides, Sulfates, Iron, Trace elements, Radioactivity, Geology.
Identifiers: *Hungary.

Geological and hydrological studies of Hungary show the presence of 975 thermal water wells, of discharges varying from 200 to 2000 l/min. There are numerous occurrences of mineral waters of Na-bicarbonate Ca-Mg, NaCl, Sulfate, Al-Fe, Sulfide, and I-Br types. Some mineral and therapeutic waters contain radioactive minerals, such as radium and disintegration products of radium, thorium, and actinium. (See W70-05487). (Gabriel-USGS)
W70-05491

GENERAL ASPECTS OF THERMAL ACTIVITY IN ICELAND,
S. Arnorsson, J. Jonsson, and J. Tomasson.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 77-86, 1969. 10 p, 3 fig, 3 tab, 13 ref.

Descriptors: *Thermal water, *Aquifers, *Groundwater, Water temperature, Geology, Igneous rocks, Springs, Boreholes, Discharge (Water), Salinity, Heating, Mapping, Mineral water, Water chemistry.
Identifiers: *Iceland.

Thermal areas in Iceland have been classified into high and low temperature areas. The high temperature areas are confined to the active volcanic belt, frequently associated with acid volcanic rocks. The low temperature areas are mainly situated in the Tertiary flood basalt areas. The total flow from thermal springs and drillholes is estimated at the present as some 2700 l/sec with an average temperature of roughly 120 deg C. With few exceptions the Icelandic thermal waters are low in total dissolved solids in particular those elements not influenced by mineral equilibria with the wall rock. Most of the utilized thermal energy is used for domestic heating purposes. (See W70-05487). (Gabriel-USGS)
W70-05492

ITALIAN THERMAL AND MINERAL SPRINGS,
A. V. Damiani, and A. Moretti.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 87-98, 1969. 12 p, 1 fig, 3 tab, 7 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Geology, Mapping, Water temperature, Water chemistry, Sulfates, Sodium, Potassium, Carbonates, Boreholes, Igneous rocks, Sulfides.
Identifiers: *Italy.

The geological, thermal, and chemical characteristics of mineral hot (over 20 deg C) and cold (less than 20 deg C) springs of Italy are described. The thermal springs are associated with the strong magnetic activity taking place in the Veneto Maremma, Latium, Campania, Sicily, and Sardinia districts. The cold springs are associated with Upper Miocene sediments. Many of the hot springs are characterized by relatively large contents of Cl, sulfate, bicarbonate, Na, Ca and Mg. Lacco Amero and Tivoli hot springs contain relatively high amounts of carbon dioxide and Ra. The cold springs are characterized by their relatively high sulfur, bromine and iodine, radio-activity, or arsenic contents. (See W70-05487). (Gabriel-USGS)
W70-05493

GENERAL REVIEW OF THE MINERAL AND THERMAL WATERS OF ROMANIA (FRENCH),
C. Ghenea, and M. Nicolescu.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 99-112, 1969. 14 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Mineral water, *Thermal water, *Aquifers, *Groundwater, Geology, Mapping, Discharge (Water), Water temperature, Salinity, Sulfides, Carbon dioxide, Carbonates, Calcium, Sodium, Magnesium, Iron, Potassium.
Identifiers: *Romania.

Romania contains several thousands occurrences of mineral and thermal waters associated with various geological provinces. The temperature of thermal and mineral waters varies from less than 20 deg C to about 87 deg C, with mineral waters characterized by mineralization of 1 g/l to 266 g/l. Mineral lakes of the Romanian plain are characterized by mineralization 16.96 g/l (B. almara) to 299.82 (Movila Mirosei). Mineral waters of Romania have relatively high concentrations of bicarbonate, Cl, Na, Ca, Mg, K, some sulfate and some I, Br, carbon dioxide and hydrogen sulfide. Thermal waters are utilized for therapeutic purposes. (See W70-05487). (Gabriel-USGS)
W70-05494

MINERAL AND THERMAL WATERS OF SPAIN (SPANISH),
Juan Manuel Lopez de Azcona.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 113-125, 1969. 13 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Mineral water, *Thermal water, *Groundwater, *Aquifers, *Springs, Mapping, Geology, Structural geology, Discharge (Water), Water temperature, Hydrogeology, Water chemistry, Water utilization.
Identifiers: *Spain.

Hydrogeological, chemical, and geographical characteristics of thermal and mineral waters of Spain are briefly described. An historical review of the effect of earthquakes on water level fluctuations of thermal and mineral springs of Spain is given. (See W70-05487). (Gabriel-USGS)
W70-05495

MINERAL AND THERMAL WATERS OF SWEDEN,
P. Engqvist.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 127-131, 1969. 5 p, 1 fig, 1 tab.

Descriptors: *Mineral waters, *Thermal waters, *Springs, *Aquifers, *Groundwater, Boreholes, Salinity, Geology, Water chemistry, Calcium, Magnesium, Chlorides, Sulfates, Discharge (Water), Sodium, Mapping, Water temperature.

Identifiers: *Sweden.

Chemical analysis are given for water from 43 boreholes passing through mineral water-bearing horizons of Quaternary, Triassic, Cretaceous, Silurian, Ordovician, and Archean age at depths of 4 to 1,855 meters in Sweden. The waters are mainly of chloride type with relatively small contents of sulfate, bicarbonate, Na, Ca, and Mg. The occurrence of thermal water in Sweden is not completely known. (See W70-05487). (Gabriel-USGS)
W70-05496

MINERAL SPRINGS OF SWITZERLAND (GERMAN),
J. Cadisch.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 133-137, 1969. 5 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Mineral water, *Springs, *Groundwater, *Thermal water, Water temperature, Mapping, Aquifers, Salinity, Discharge (Water), Radioactivity, Water chemistry, Carbon dioxide, Iron, Sulfides, Strontium radioisotopes, Fluorine, Arsenic compounds.
Identifiers: *Switzerland.

A map of the distribution of mineral and thermal springs in Switzerland is presented. Chemical character, radioactivity, temperature, discharge, and free carbon dioxide content of 39 mineral spring occurrences are given. Many springs utilized for therapeutic purposes are characterized by the presence of Li, Fe, Sr, Br, I, F, B, and S. (See W70-05487). (Gabriel-USGS)
W70-05497

MINERAL AND THERMAL WATERS OF THE UNITED KINGDOM,
W. M. Edmunds, B. J. Taylor, and R. A. Downing.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 139-158, 1969. 20 p, 5 fig, 4 tab, 16 ref.

Descriptors: *Mineral water, *Thermal water, *Springs, *Groundwater, *Aquifers, Geology, Water chemistry, Mapping, Water utilization, Salts, Brines, Iron, Calcium, Magnesium, Sodium, Potassium, Sulfates, Carbonates, Trace elements, Discharge (Water).
Identifiers: *United Kingdom.

The mineral waters of the United Kingdom are classified according to their chemical characteristics and related geological environments. A map shows the distribution of mineral and thermal waters. A brief survey is made of the current usage of mineral waters, with particular attention to brine extraction. The mineral waters are found in several geological horizons from Eocene to Ordovician age, and can be subdivided into the four types as follows: (Ca, Mg) sulfate, (Ca, Mg) Cl, (Na+K) Cl, and (Na+K) sulfate. Li, Sr, Ba, I, Br, phosphate, Mn, Ni, and Fe are the minor constituents of these waters. (See W70-05487). (Gabriel-USGS)
W70-05498

THERMAL, MINERAL, AND INDUSTRIAL WATERS OF THE SOVIET UNION,
F. A. Makarenko, I. K. Zaitzev, V. V. Ivanov, and V. F. Mavritzky.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 159-177, 1969. 19 p, 3 fig, 20 ref.

Descriptors: *Thermal water, *Mineral water, *Industrial water, *Aquifers, *Groundwater, Geology, Geological structures, Hydrogeology, Artesian wells, Mapping, Water temperature, Discharge (Water), Radioactivity, Water chemistry, Sulfides, Carbon dioxide, Trace elements.
Identifiers: *USSR.

General information, expressed in diagramatic maps is given on the mineral thermal, and industrial waters of the Soviet Union. The maps show the fundamental regularities in the development of the USSR underground mineral and thermal waters indicating the presence of 5 hydrochemical provinces as follows: thermal waters in areas of latest volcanism; carbon dioxide waters in areas of young magmatic activities (Quaternary and Neogene); nitrogen-bearing thermal waters in areas of young tectonic faults; nitrogen, nitrogen-methane, and methane waters of artesian basins; and oxygen-nitrogen radon waters of acid crystalline rocks. The mineral balneological waters of the union consist of the following types: waters without specific components or properties; carbon dioxide; sulfide waters; arsenic waters with high content of Mn, Cu, Al, Radon (radioactive) waters; and siliceous thermal waters. Industrial mineralized waters of the Soviet Union are described in some details. (See W70-05487). (Gabriel-USGS)
W70-05499

IRRIGATION AND MUNICIPAL WELLS IN THE SAN LUIS VALLEY, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 04B.
W70-05508

GEOHYDROLOGY AND GROUNDWATER POTENTIAL OF ST. JOSEPH COUNTY, INDIANA,
Geological Survey, Indianapolis, Ind.
J. D. Hunn, and J. S. Rosenshein.
Indiana Division of Water Bulletin No 33, 1969. 20 p, 5 fig, 3 plate, 4 tab, 19 ref.

Descriptors: *Water resources, *Groundwater, *Indiana, *Glacial drift, Aquifers, Sands, Gravels, Hydrogeology, Data collections, Hydrologic data, Surveys, Investigations.
Identifiers: *St. Joseph County (Ind).

The principal sources of groundwater in St. Joseph County, Indiana are unconsolidated rocks of Quaternary age. These rocks form a single but complex hydrologic system that is locally more than 450 feet thick and consists of three units. The groundwater potential of the county is estimated to be 400 mgd of which about 54 mgd is being pumped. Unit 3, a sand and gravel unit, is the principal aquifer of the county. This unit is partly artesian and partly water table. Recharge is estimated to average 200,000 gpd per square mile, or about 40 mgd. Possible yields to individual wells range from about 25 to more than 3,000 gpm. (Knapp-USGS)
W70-05509

2G. Water in Soils

CLOGGING OF POROUS COLUMN OF SPHERES BY SEDIMENT,
California Univ., Berkeley. Coll. of Engineering.
For primary bibliographic entry see Field 02J.
W70-05151

SEEPAGE STUDY USING ELECTRICAL ANALOG,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering; and Technische Universitaet, Berlin (West Germany). Dept. of Water Structure and Water Economy.
Heinz Stefan, and Johannes Meyer.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7064, p 411-416, February 1970. 6 p, 5 fig, 3 ref.

Descriptors: *Analog models, *Seepage, *Porous media, Groundwater movement, Soil water movement, Analog computers, Permeability, Dams, Model studies, Leakage, Reservoir leakage, Reservoir design.
Identifiers: Seepage models.

A simple and inexpensive electrical analog is considered, which was used to study two-dimensional seepage in heterogeneous media. It consists of multiple layers of conductive paper. Simple techniques for the analog assembly are described. The analog technique is applied to a study of flow through two pervious layers of different permeabilities under a structure with a cutoff wall upstream. Results with regard to flow rates, pressure head distributions and exit pressure gradients are presented in dimensionless and graphical form. (Knapp-USGS)
W70-05155

SEASONAL VARIATION OF HYDRAULIC PARAMETERS AND THEIR INFLUENCE UPON SURFACE IRRIGATION APPLICATION EFFICIENCY,
North Dakota State Univ., Fargo; and Rock Island Arsenal, Ill.
For primary bibliographic entry see Field 03F.
W70-05235

SOME LIMITATIONS ON ESTIMATES OF INFILTRATION AS A BASIS FOR PREDICTING WATERSHED RUNOFF,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center; and Arizona Agricultural Experiment Station, Tucson.
R. B. Hickok, and H. B. Osborn.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 798-800, 803, November-December 1969. 1 tab, 10 ref.

Descriptors: *Infiltration, *Soil surfaces, *Rainfall-runoff relationships, *Runoff, *Watersheds (Basins), Surface runoff, Subsurface runoff, Mathematical models, Hydrologic cycle, Hydrology, Model studies, Hydrologic data, Semiarid climates, Small watersheds, Rainfall intensity, Depth-area-duration analysis.
Identifiers: Unit-source watersheds, Walnut Gulch Experimental Watershed (Ariz).

The concept of infiltration does not generally provide an adequate model of watershed rainfall-runoff relationships, nor does it satisfactorily yield precise runoff predictions. This is due in part to the fact that mathematical models have not adequately represented such complex influences on infiltration as the interrelations of soil characteristics, microrelief, ground cover, and rainfall characteristics. A second problem with this concept is the invalid assumption that the soil surface divides rainfall into two parts which then pursue distinct courses through the hydrologic cycle. Since this assumption requires a homogeneity of watershed soils and geology which seldom exists naturally, it places limitations of the use of small-plot experimental data. The most useful index to quantify overall operational characteristics of unit-source watersheds may be apparent net infiltration. This could also be used to derive relationships of hydrologic behavior of watersheds to their measurable physical parameters. Such an index cannot be synthesized from small-plot infiltrometers or infiltration measurements from a laboratory. (Carr-Arizona)
W70-05290

EFFECT OF SOIL PROFILES ON MOVEMENT OF WATER ON SUBSURFACE IRRIGATION,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
L. F. Whitney, Kazuki Muta, and E. S. Pira.
American Society of Agricultural Engineers, Transactions, Vol 12, No 1, p 98-99, January-February 1969. 7 fig, 1 tab, 6 ref.

Descriptors: *Subsurface irrigation, *Irrigation systems, *Interfaces, *Soil texture, *Soil profiles, Topsoil, Subsoil, Irrigation design, Soil water movement, Water pressure, Soil moisture.

Research was concerned with the reaction of water movement when water from a pressurized source reached the interface between soils of different textures. The beneficial effects of a layered soil profile

for subsurface irrigation were demonstrated. This is particularly useful in subsurface irrigation of turf areas such as golf courses which are constructed to specifications. In irrigation of crops, however, the pipe network must be placed below tillage level. If the nozzles lie below the interface it is unlikely that irrigation water will reach shallow-rooted crops. If the nozzles are above the interface, i.e., the top 16 inches of soil is homogeneous, then subsurface irrigation can be effectively employed. (Carr-Arizona)
W70-05291

DEPTH OF DRAINAGE IN IRRIGATED AREAS,
California Univ., Davis. Dept. of Water Science and Engineering.
James N. Luthin, and Frank Robinson.
American Society of Agricultural Engineers, Transactions, Vol 12, No 1, p 27-28, 31, January-February 1969. 3 p, 3 fig, 1 tab, 6 ref. Water Resources Center Project No. W125-3U-63/70.

Descriptors: *Drainage, *Salinity, *Capillary action, *Hydraulic conductivity, *Irrigation water, Irrigated land, Soil water movement, Leaching, Saline water, Salts, Stratification, Water table, Crop response, Saline soils, Infiltration.
Identifiers: Imperial Valley (Calif).

Observations and field measurements of water tables and soil salinity in the Imperial Valley indicate that depth of drainage is not solely influenced by capillary rise from the water table. Among the other influencing factors are infiltration rate, soil stratification, salinity of irrigation water, cropping pattern, irrigation practices, and hydraulic conductivity. In soils of low to moderate hydraulic conductivity the major factor in the accumulation of salts in the root zone is the low conductivity itself, making it difficult to apply enough water to satisfy leaching requirements. In such a case, capillary rise is probably a minor factor in accumulation of salts. However, in sandy soils of high hydraulic conductivity, leaching is easily achieved. Such soils permit accumulation of salts in the root zone by capillary action. Under these conditions, capillary rise may be an important cause of soil salinization. (Carr-Arizona)
W70-05292

2H. Lakes

FORMATION AND MAINTENANCE OF THERMOCLINES IN STRATIFIED LAKES INCLUDING THE EFFECTS OF POWER PLANT THERMAL DISCHARGES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
For primary bibliographic entry see Field 05C.
W70-05050

TEMPERATURE VARIATIONS IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.; and California Univ., Los Angeles. School of Engineering and Applied Science.
G. T. Orlob, and L. G. Selna.
Journal of the Hydraulics Division, ASCE, Vol 96, No HY2, Proc. Paper 7063, p 391-410, February, 1970. 10 fig, 1 tab, 19 ref.

Descriptors: *Hydraulics, *Thermal pollution, *Thermal stratification, Epilimnion, Hypolimnion, Mathematical models, Meteorological data, Reservoirs, Temperature.

A mathematical model is developed to study the thermal behavior of freshwater impoundments. The model is formulated to stimulate thermal stratification, turnover, hypolimnetic behavior, and epilimnetic behavior. In developing the model it is assumed that for the reservoir all transfers of heat energy can be accomplished along a single axis, in this case the vertical. Thus, the water body must be segmented along this axis, and the necessary water and energy equations must be written accordingly. It is concluded from the effective diffusion and temperature profiles of selected impoundments that the effective mixing in the epilimnion is greatest near the surface but declines rapidly with depth as the thermocline is approached. The effective diffusion coefficient is minimal at or very near the position of the maximum temperature gradient, the so-called 'thermocline'. In the hypolimnion the effective diffusion coefficient increases with depth in a more or less erratic manner, reaching a maximum roughly equivalent to that of the epilimnion at about mid depth, thereafter decreasing as the bottom is approached. Transfer of energy into deep stratified impoundments is accomplished by four primary mechanisms: advection, direct solar insolation, convection mixing associated with cooling at the surface and effective diffusion identified by momentum transfer. The transfer of energy from the epilimnion to the hypolimnion by the diffusive mechanism is limited at the thermocline by a strong density difference. Predicted and measured quantities show excellent comparison. (Upadhyaya-Vanderbilt)
W70-05053

WATER MASSES AND THEIR MOVEMENTS IN WESTERN LAKE ERIE,
Ohio State Geological Survey, Columbus.
Charles E. Herdendorf.
Ohio Geological Survey Report of Investigations No 74, 1969. 7 p, 4 fig, 4 ref.

Descriptors: *Lake Erie, *Limnology, *Flow, Chemical properties, Currents (Water), Water chemistry, Hydrology, Water levels, Tracking techniques.
Identifiers: Water mass movement.

A synoptic survey of several of the physical and chemical characteristics of the water in western Lake Erie was conducted on June 23, 1963. The main objective of the study was to determine the feasibility and value of a synoptic survey of water properties as a method of mapping water masses and of determining their origins and paths of movement. This basin is the recipient of large influxes of water, each with its distinctive properties, from the Detroit and Maumee Rivers and from the central basin of Lake Erie. Sampling stations were established on a two-mile grid, resulting in a total of 300 stations. At each station water samples were taken with Kemmerer water samplers at two depths: 5 feet below the surface and 2 feet above the bottom. At the time of sampling, water temperatures were measured to the nearest degree Fahrenheit. The computed velocities are generally substantiated by direct measurements. Temperature and conductivity values indicate a dominating southward movement of the Detroit River water. A northwestward flow of central Lake Erie water into the southern islands area and south of Pelee Point is also recognized. Most of the flow from western Lake Erie into the central basin appears to be through Pelee Passage. Variations in water levels, when correlated with podlike masses of water which have entered the lake from the Detroit River, provide data for determining the velocity of their movements. The average velocity of Detroit River water flow in western Lake Erie is approximately 0.5 ft/sec. (Knapp-USGS)
W70-05076

RESPIRATORY ENERGY EXPENDITURE BY THE PREDACEOUS ZOOPLANKTER LEPTODORA KINDTII (FOCKE) (CRUSTACEA: CLADOCERA),
Pittsburgh Univ., Pa. Pymatuning Lab. of Ecology; and Youngstown Univ., Ohio. Dept. of Biology.
Gerald A. Moshiri, Kenneth W. Cummins, and Robert R. Costa.
Limnology and Oceanography, Vol 14, No 4, p 475-484, 1969. 4 fig, 5 tab, 21 ref.

Descriptors: *Zooplankton, *Respiration, *Temperature, Hydrogen ion concentration, Dissolved oxygen, Crustaceans.
Identifiers: Respiratory quotient, Leptodora kindtii, Male oxygen consumption, Female oxygen consumption, Cladocera.

Oxygen consumption, carbon dioxide production, and respiratory quotients were determined for a natural population of the predaceous Leptodora kindtii during two growing seasons under a variety of laboratory conditions. The zooplankter exhibited a respiratory regulatory plateau over the temperature range from 15 to 25C. Males consumed more oxygen than fecund females. Annual respiration was calculated to be 22.5 kilocalories/cubic meter year in 1966 and 111.4 kilocalories/cubic meter year in 1967, corresponding to 4,625 and 23,302 millilliter oxygen/cubic meter year, respectively. (Wilde-Wisconsin)
W70-05085

NEGATIVE THERMAL GRADIENT UNDER ALPINE LAKE IN HAWAII,
Hawaii Inst. of Geophysics, Honolulu.
A. H. Woodcock, and Gordon W. Groves.
Deep-Sea Research, Supplement to Vol 16, p 393-405, 1969. 9 fig, 3 tab, 13 ref.

Descriptors: *Lakes, *Alpine, *Volcanoes, Ice.
Identifiers: *Lake Waiau (Hawaii), *Douglas Cone (Hawaii), *Alpine lakes, Thermal gradient, Ground ice, Cold-rim effect, Impeded seepage, Hawaii, Mauna Kea (Hawaii), Artic lakes, Warm-rim effect, Dark Lake (Wis), Perched water.

The assumption that some alpine lakes owe their origin to water perched over ground ice was tested by thermal probing of the substratum sediment of the small Lake Waiau at about 4000 meter level of the volcano Mauna Kea, Hawaii. A series of measurements established a mean negative thermal gradient of about 0.052C. The decrease in temperature of the sediment with depth may not be necessarily due to the presence of buried ice, but to a cold-rim effect transmitted by the surrounding volcanic debris. A similar, thus far unexplained, thermal condition was recently found at an arctic lake in Mackenzie River Delta, Canada. (Wilde-Wisconsin)
W70-05088

THE USE OF COPPER SULPHATE FOR ERADICATING THE PREDATORY FISH POPULATION OF A LAKE,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
M. W. Smith.
Transactions American Fisheries Society, Vol 65, p 101-114, 1935. 3 tab, 28 ref.

Descriptors: *Copper sulfate, *Population, *Lakes, Salmon, Trout, Fry, Habitat, Runoff, Organic matter, Hydrogen ion concentration, Plankton, Proteins, Inorganic compounds, Bacteria, Surfaces, Depth, Temperature, Oxygen, Bicarbonates, Algicides, Beggiatoa, Zooplankton, Copepods, Littoral, Eels, Catfishes, Killifishes, Perches, Suckers, Sticklebacks.
Identifiers: *Fish eradication, *Predatory fish, Lake Jesse (Nova Scotia), Lake Hectanooga (Nova Scotia), Hyalotheca, Tabellaria fenestrate, Aphanothece, Palmella, Kirchneriella, Asterionella formosa, Tabellaria flocculosa, Fragilaria, Cladocerans, Chironomics, Sedges, Peridinium, Dinobryon, Chrococcus, Closterium.

An experiment was attempted to create a suitable habitat for planting trout fry, by eliminating existing predatory fish populations. Copper sulphate was added to Lake Jesse, Nova Scotia, in sufficient amounts to kill most fish. Upon return to generally suitable conditions, trout fry were to be planted in both Jesse and Hectanooga Lakes, the latter serving as control. After application, water samples were analyzed for copper content. Removal of copper sulphate from Lake Jesse may have occurred by runoff, by combination with organic matter, and by precipitation with inorganic compounds. Temperature, pH value, oxygen, and bicar-

bonate observations were made. Practically all algae studied were killed by a concentration of .50 parts/million. The effective concentration varied for each species, probably depending upon temperature and chemical conditions of the waters. There was no apparent effect on rooted, submerged, and emergent vegetation, however the salt was added past the growing period. The limnetic zooplankton was completely destroyed as far as determined. Considering the dosage, it was expected that the fish of Lake Jesse would be annihilated, which proved correct, but an undeterminable number of fish did survive. (Jones-Wisconsin)
W70-05090

AGE AND MORPHOLOGY OF SMALL LAKE BASINS, SOUTHERN HIGH PLAINS, TEXAS AND EASTERN NEW MEXICO,
Texas Technological Coll., Lubbock. Dept. of Geology.
C. C. Reeves, Jr., and W. T. Parry.
The Texas Journal of Science, Vol 20, No 4, 349-354, 1969. 3 fig, 8 ref.

Descriptors: *Lakes, *Basins, Age, Lake morphology, Sand dunes.
Identifiers: *West Texas, *New Mexico, Southern High Plains, Small lake basins, Tahoka age, Pliocene caliche, Vigo park, Altithermal, Deflation basin.

The southern High Plains of west Texas and eastern New Mexico are pockmarked by thousands of small, dry lake basins, the majority of which are 20-30 feet deep and about 1/4 to approximately one mile in diameter. Transverse dunes which fringe on many of the larger basins indicate a deflation origin. Dunes associated with the older basins indicated a S 30-80 degree east prevailing wind which places their formation sometime during the 5,000-25,000 B P period. Other lines of evidence suggest the Vigo Park and Altithermal intervals, 17,000 and 6,500-5,000 years B P. The small, younger basins, without fringe dunes, represent deflation during the last few thousand years or natural topographic undulations. However, some also represent larger basins that have been nearly filled with lacustrine sediment. The morphology of the lakes is described: basins along abandoned stream channels are elongated; recent basins are circular; and older basins are subcircular to elliptical. (Haskins-Wisconsin)
W70-05095

CHEMICAL CHARACTERISTICS OF ONTARIO LAKES AS RELATED TO GLACIAL HISTORY,
Department of Lands and Forests, Maple (Ontario). Research Branch.
R. A. Ryder.
Transactions American Fisheries Society, Vol 93, p 260-268, 1964. 8 fig, 14 ref.

Descriptors: *Productivity, *Alkalinity, *Dissolved solids, *Lakes, Glacial drift, Chemical properties.
Identifiers: *Glacial regions, *Ontario lakes, Canada, Precambrian Shield Regions, Extinct Pleistocene lakes, Regions of Past Marine Submergence.

More accurate prediction of potential biological productivity are possible by interpreting relationships between dissolved solids and alkalinity in a lake. Surface water samples were collected from 310 Ontario lakes over a three year period and analyzed for total alkalinity and dissolved solids. Seasonal changes in dissolved solids concentrations were found, with high concentration after ice breakup due to turnover and runoff. Peak concentrations were in August as a result of wind mixing. Total alkalinity varied less than total dissolved solids. Total dissolved solids and alkalinity varied witin watershed according to glacial history. Precambrian Shield Regions have lower concentrations than Extinct Pleistocene Lakes and Regions of Past Marine Submergence. Concentration variations within glacial regions depend upon depth of glacial drift and sedimentary materials. Little drift material results in low concentration. Mean ratio of total alkalinity to total dissolved solids is 57:100 from which a general relationship is derived. Classifying lakes according to glacial region is a simple way of ranking lakes according to productivity. (Bannerman-Wisconsin)
W70-05097

CHANGES IN ENVIRONMENT AND BIOTA OF A NATURAL LAKE AFTER FERTILIZATION,
Fisheries Research Board of Canada, St Andrews (New Brunswick). Biological Station.
M. W. Smith.
Journal Fisheries Research Board of Canada, Vol 26, No 12, p 3101-3132, 1969. 10 fig, 10 tab, 41 ref, appendix.

Descriptors: *Lakes, *Fertilization, *Fertilizers, Nitrogen, Phosphorus, Potassium, Oligochaetes, Gastropods, Phytoplankton, Zooplankton, Benthic fauna, Daphnia, Rotifers.
Identifiers: *Crecy Lake (Canada), Soft water lakes, Artificial enrichment, Inorganic fertilizers, Anabaena, Spirogyra, Isoetes, Juncus, Sparganium, Hyalella, Leptodiaptomus, Chironomidae, Hirudinae, Odonates, Sphaeriids.

Crecy Lake, New Brunswick, was enriched on three occasions (1946, 1951, 1959) with inorganic commercial fertilizers, each application sufficient to provide 210, 390 and 270 parts/billion of nitrogen (N), phosphorus (P), and potassium (K), respectively, when uniformly distributed. Concentrations of P (inorganic, organic, total) declined rapidly after fertilization. Loss of P owing to drainage amounted to 8.5-.2% of amounts added. Nitrate N concentrations rose sharply but rapidly fell to prefertilization values. Anabaena and Spirogyra blooms followed each fertilization; Anabaena blooms continued under the ice cover. Rooted aquatic vegetation increased somewhat; Isoetes and Juncus were adversely affected by algal blooms. Although Isoetes recovered well following blooms, only Sparganium appeared to benefit from fertilization. Average dry weight of zooplankton increased with each fertilization; quantities were depressed during Anabaena blooms. Peak effects on zooplankton appeared to occur at 2-4 years post-fertilization. Only Daphnia and Diaphanosoma increased appreciably due to fertilization. Hyalella azteca increased after each fertilization; population levels were in part directly related to abundance of Isoetes. Chironomids, sphaeriids and oligochaetes increased irregularly. Crecy Lake is sufficiently self-regulating that artificial enrichment was temporary and induced eutrophication was largely reversible. (Voigtlander-Wisconsin)
W70-05104

REPORT UPON THE CAUSE OF OFFENSIVE ODORS FROM LAKE MONONA, MADISON, WISCONSIN,
Alvord, Burdick and Howson, Chicago, Ill.
J. W. Alvord, and C. B. Burdick.
Engineering Report to the Mayor and City Council of Madison, Wisconsin, May 1920. 121 p. 11 fig, 10 tab, 20 ref.

Descriptors: *Odor, *Lakes, *Wisconsin, Sewage treatment, Sugar beets, Cyanophyta, Storm runoff, Winds, Decomposing organic matter, Copper sulfate, Nitrates, Nitrogen, Nitrites, Effluents, Industrial wastes, Agriculture, Drainage, Kentucky, Denitrification, United States, Minnesota, Reservoirs, Plankton, Water pollution, Diatoms, Diversion, Clathrates.
Identifiers: *Lake Monona (Wis), *Madison (Wis), Stench, Periodic recurrence, Winchester (Ky), St Paul (Minn), Lake Winnebago (Wis), Belfast (Ireland), Lake Vadnais (Minn), Clathrocystis.

Extremely offensive odors emanated from Lake Monona during the 1918 summer and fall; equally disagreeable odors were recorded for 1882, 1898, and 1913. These odors prevailed over and the periphery of the lake and were localized except when dissipated by winds, drift, and humidity, with the exception of certain bays. Blue-green algae were abundant at many points; masses of decaying algae stranded on the shores, if stirred with a stick, looked like human excrement, and smelled exactly like odors from a foul and neglected pig sty. Offensive algal growth is common, especially in shallow lakes, and often in pure water of many water works reservoirs. Although sewage may, to some degree, stimulate algae growth, they would be sufficiently luxuriant from natural causes to constitute a nuisance, even if the sewage or effluent were not allowed to reach the lake or were subject to treatment to exclude such nitrogenous matter that helps support algae. Increased knowledge of algal physiology and factors favoring plant growth is needed. Toxic doses of copper sulfate should be applied when necessary, which will be adequate to keep the algae under control and suppress it only when extensive growth threatens. (Jones-Wisconsin)
W70-05107

THE MADISON LAKES PROBLEM,
G. A. Rohlich, A. S. Johnson, G. V. Fitzgerald, George J. Schroepfer, and R. A. Bryson.
Report on investigation of a project sponsored by Oscar Mayer and Co, Madison, Wisconsin, September 15, 1955. Part I: 31 p, 17 fig, 13 tab, 9 ref; Part II: 90 p, 53 fig, 39 tab, appendix; Summary and a Program for Resolution of the Problem, 15 p.

Descriptors: *Lakes, *Wisconsin, *Eutrophication, *Chemicals, *Hydrographs, Sewage effluents, Water pollution control, Water pollution sources, Water pollution effects.
Identifiers: *Madison (Wis), Yahara River watershed, Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis).

This two-part report summarized results of the previous and 1955 studies of complex problems relevant to pollution of four large lakes in the vicinity of Madison, Wisconsin. The scope of investigations embraced physical, chemical, and biological conditions of the lakes, factors related to diversion of sewage effluent, possibilities of controlling addition of nutrients, and management potentialities of the Yahara River watershed. The report is supplemented by a 15-page summary of investigations and a program for resolution of the problem. The question of effluent disposal requires additional information on the composition of Madison lakes, connecting rivers, and Badfish Creek-Yahara River-Rock Creek system. The major channels toward reduced eutrophication include removal of nutrients from effluent by irrigation, or chemical and physical methods, use of stabilization ponds, and diversion of Door Creek, an important contributor of nutrients. Shoreline sanitation and weed harvesting, and elimination of rough fish are other means of decreasing the nutrient content of these lake waters. (Wilde-Wisconsin)
W70-05110

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1942 TO JULY 1943,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
C. N. Sawyer, J. B. Lackey, and A. T. Lenz.
Report to Governor's Committee, Madison, Wisconsin, 1943. 79 p. 15 fig, 4 tab, 22 ref, Appendix.

Descriptors: *Odor-producing algae, *Nuisance algae, *Wisconsin, *Lakes, Productivity, Nitrogen, Phosphorus, Drainage, Marshes, Farms, Cyanophyta, Plankton, Zooplankton, Eutrophication, Storm drains, Sewage effluents, Streamflow, Measurement, Water pollution, Fertilization, Industrial wastes, Garbage dumps, Oil wastes, Inlets (Waterways), Organic matter, Potassium, Sulfates,

Crustaceans, Diatoms, Copper sulfate, Dinoflagellates, Euglenophyta, Chlorophyta, Chlamydomonas, Fungi.
Identifiers: *Madison (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis), Blooming, Lake Mendota (Wis), Lake Wingra (Wis), Anabaena spiroides, Microcystis aeruginosa, Cryptomonadida, Mastigophora, Cryptophyceae, Chrysophyceae, Volvocales, Sarcodina, Ciliates, Cyclotella, Aphanizomenon flos aquae, Melosira, Asterionella formosa, Fragilaria, Stephanodiscus, Pandorina.

Madison lakes, especially the shallow downstream lakes below the city, have been troubled during warm seasons with offensive odors and unsighlty shorelines. The major cause of the offensive conditions are a direct result of accumulations of algal growths in advanced stages of decomposition. These growth stimulations are related to fertilization of the water with minerals, such as nitrogen, phosphorus, potassium, and possibly other enriching elements and compounds. Drainage from rich agricultural areas and urban communities into shallow lakes enhances algal problems. Nitrogen is shown to be one of the major componential elements, with phosphorus minor. Nuisances in inland lakes are largely members of the plant kingdom. Domestic sewage, although highly purified by modern treatment methods, is rich in phosphorus, nitrogen, potassium, and possibly other elements. The most obnoxious blooms are those of blue-green algae, particularly Anabaena and Microcystis. Excessive amounts of plankton are related to agricultural drainage. Lakes Monona, Waubesa, and Kegonsa are additionally enriched by storm sewers, other than rain water, and by sewage treatment plant effluent. (See W70-05113). (Jones-Wisconsin)
W70-05112

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1943 TO JULY 1944,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
C. N. Sawyer, J. B. Lackey, and A. T. Lenz.
Report to Governor's Committee, Madison, Wisconsin, 1945. 92 p. 23 fig, 29 tab, Appendix.

Descriptors: *Algae, *Lakes, *Eutrophication, *Hydrology, Chemical properties, Wisconsin, Sewage effluents, Nitrogen, Phosphorus.
Identifiers: *Truax Field (Madison) effluents, *Madison lakes, Yahara River (Wis), Storkweather Creek (Wis), Nine Springs Creek (Wis), Door Creek (Wis), Dutch Mill Drainage Ditch (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis).

The three parts of this voluminous report present results of detailed hydrological, chemical, and biological investigations of the three Madison lakes and their tributaries. The study confirmed that the objectional growth of algae and lake bloom are primarily induced by inorganic forms of nitrogen and phosphorus of sewage effluents. Nuuisance blooms are attributed chiefly to blue-green algae. The results of laboratory experiments indicated that removal of soluble nitrogen and phosphorus from sewage would materially decrease the algal density. The critical contents of nitrogen and phosphorus in the lake waters were established as 0.30 and 0.015 ppm, respectively. A suggestion is made to duplicate laboratory trials in artificial ponds treated with sewage and sewage freed from its nitrogen and phosphorus. (See W70-05112). (Wilde-Wisconsin)
W70-05113

CHEMICAL AND THERMAL CHARACTERISTICS OF KEYSTONE RESERVOIR,
Oklahoma Water Resources Research Inst., Stillwater.
Troy C. Dorris.
Available from the Clearinghouse as PB-190 571, $3.00 in paper copy, $0.65 in microfiche. Oklahoma University Water Resources Research Institute Project Completion Report, 1969. 191 p, 51 fig, 46 tab, 168 ref, append. OWRR Project No. A-002-OKLA.

Descriptors: *Limnology, *Reservoirs, Water quality, Dissolved oxygen, Water temperature, Discharge (Water), Stratification, Nutrients, Eutrophication, Heat budget, Data collections, Hydrologic data, Computer programs.
Identifiers: Keystone Reservoir (Okla).

Physicochemical limnology of Keystone Reservoir during 1965-66 was compared to 1966-67. Spatial and temporal variations in the rate of community metabolism in the Cimarron arm during 1966-67 were estimated. A change from epilimnetic reservoir discharge during 1965-66 to hypolimnetic discharge during 1966-67 produced marked differences in the intensity of stratification, circulation patterns and effects of impoundment on water quality. Approximately 86% of the average annual inflow of suspended solids from the Cimarron River was lost to sediments. The average annual heat budget of Keystone Reservoir was 17,217 cal per sq cm, and the reservoir had an average negative winter heat income of -995 cal per sq cm. Concentrations of total phosphorus increased with depth and decreased downstream. Total phosphorus content of the Cimarron arm increased from 14.3 to 45.8 metric tons between September 1966 and August 1967. Biochemical and chemical oxygen demands decreased downstream and were inversely related to water temperature. Community respiration accounted for 80.0% of average oxygen losses while diffusion-out accounted for 19.7% and reservoir discharge accounted for 0.3%. (Knapp-USGS)
W70-05121

A STUDY OF THE EFFECTS OF WAVES ON EVAPORATION FROM FREE WATER SURFACES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
For primary bibliographic entry see Field 02D.
W70-05208

A LIMNOLOGICAL INVESTIGATION OF WATER QUALITY CONDITIONS IN LAKE SAMMAMISH,
Seattle Metropolitan Municipality, Wash.
For primary bibliographic entry see Field 05C.
W70-05256

EFFECTS OF THERMAL STRATIFICATION AND NUTRIENT AVAILABILITY ON THE PRODUCTIVITY OF RESERVOIR PHYTOPLANKTON,
Tennessee Valley Authority, Chattanooga. Biology Section.
For primary bibliographic entry see Field 05C.
W70-05274

DISTRIBUTION AND ABUNDANCE OF PHYTOPLANKTON AND ROTIFERS IN A MAIN STEM MISSOURI RIVER RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
Patrick L. Hudson, and Bruce C. Cowell.
Proceedings of South Dakota Academy of Science, Vol 45, p 84-106, 1966. 7 fig, 5 tab, 16 ref.

Descriptors: *Reservoirs, *Phytoplankton, *Rotifers, *Distribution, Missouri River, South Dakota, Nebraska, Algae, Nannoplankton, Diatoms.
Identifiers: *Lewis and Clark Lake (S D), Abundance, Blue-green algae, Green algae, Fragilaria, Asterionella, Melosira, Microcystis, Keratella, Polyarthra, Asplanchna, Branchionus.

Weekly samples were taken at ten stations in Lewis and Clark Lake Reservoir, bordering South Dakota-Nebraska, from May to October; additional samples were obtained from an automatic plankton sampler at the discharge. Mean numbers of net phytoplankton increased from headwaters to the dam; volumes of net phytoplankton per liter of water varied irregularly throughout the reservoir. Data from the reservoir discharge indicate nannoplankton comprised 84% of phytoplankton volume. Discharge of phytoplankton totalled 9,058 metric tons for one year with peak discharges occurring in March, May and August. Phytoplankton discharge does not appear to be directly related to volume of water discharged. Diatoms were dominant phytoplankter in all months except August (green algae) and October (blue-green algae). Abundance of rotifers increased from headwaters downstream. Dominant rotifers in terms of months present and mean numbers per liter were Polyarthra, Asplanchna and Keratella; ten additional genera were noted. Seasonal abundance figures indicate a single peak in late spring--early summer. Highest total mean values occurred in April and June; lowest totals were in November and January. Graphical and tabular data include monthly averages of phytoplankton and rotifer densities. (Voigtlander-Wisconsin)
W70-05375

THE PHYSICAL-CHEMICAL LIMNOLOGY OF A NEW RESERVOIR (BEAVER) AND A FOURTEEN YEAR OLD RESERVOIR (BULL SHOALS) LOCATED ON THE WHITE RIVER, ARKANSAS AND MISSOURI,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
James W. Mullan, and Richard L. Applegate.
Southeastern Association of Game and Fish Commissioners 19th Annual Conference, p 413-421, 1965. 4 fig, 1 tab, 8 ref.

Descriptors: *Reserviors, *Limnology, *Physicochemical properties, Arkansas, Missouri, Temperature, Dissolved oxygen, Transparency, Water circulation, Thermal properties, Phosphorus, Nitrogen, Organic matter, Conductivity, Heat budget, Chemical analysis.
Identifiers: Beaver Reservoir (Ark-Mo), Bull Shoals Reservoir (Ark-Mo), White River (Ark-Mo), Arkansas-Missouri Ozarks.

Beaver and Bull Shoals Reservoirs are similar in mean depth, maximum depth, bottom slope and shoreline development factor; they differ in age and size. Maximum transparency in Bull Shoals occurred in early fall (Secchi disk = 7 meters), minimum transparency occurred in early spring (0.3 to 3.7 meters). Values for Beaver were 30 to 65% of Bull Shoals; maximum value was 4 meters. Both reservoirs stratified in June; annual heat budgets were 27,800 to 28,300 gram-calories for Bull Shoals, and 20,700 for Beaver. Bull Shoals showed higher alkalinity (pH 7.9 vs 7.0 for Beaver, median total alkalinity 130 vs 60 for Beaver). Dissolved organic matter in Bull Shoals was about 83 to 86% of that recorded in Beaver (medians for two years of 6.1 and 5.4 milligram/liter vs 7.1 and 6.5 for Beaver). Beaver had slightly higher concentrations of nitrogen, phosphorus and some trace elements. Although this may indicate slightly greater nutrient availability in the younger reservoir, measurements of all parameters failed to demonstrate a significantly higher nutrient base in Beaver Reservoir. Graphical and tabular data include temperature, heat content and dissolved oxygen profiles and a complete summary of chemical analyses (25 parameters) for both reservoirs. (Voightlander-Wisconsin)
W70-05380

SAMPLING RESERVOIR FISH POPULATIONS USING MIDWATER TRAWLS,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark. South Central Reservoir Investigations.
Alfred Houser, and Horace E. Bryant.
Reservoir Fishery Resources Symposium, Athens, Georgia, April 5-7, p 391-404, 1967. 4 fig, 8 tab, 9 ref.

Descriptors: *Methodology, *Fish populations, *Reservoirs, Standing crop, Mortality, Sampling, Arkansas, Pounds fish per acre, Analytical techniques, Impoundments, Forage fish, Fish, Missouri.
Identifiers: Warm water fish, Threadfin shad, Gizzard shad, Bull Shoals Reservoir (Ark-Mo), White River (Ark-Mo), Beaver Reservoir (Ark-Mo), Population estimates, Mortality coefficients.

A midwater trawling technique and analytical procedures for population estimates were employed in Bull Shoals and Beaver Reservoirs on the White River. Emphasis was placed on evaluating the utility of midwater trawling methods for population analysis. Of 16 fish species captured, only two, gizzard and threadfin shad, yielded sufficient numbers for population estimates. Trawling was carried out in 8-foot vertical strata throughout the summer; population estimates were based on catch/unit of effort in each stratum. Both shad species showed dramatic young-of-the-year losses through summer. In Beaver Reservoir, young threadfin shad decreased from 290 million in July to 42 million fish in September; young gizzard shad decreased from 244 million to 2 million over the same period. For 0-age threadfin, mortality coefficients (M) as defined by the expression N-sub-1/N-sub-2=exp (-Mt), where t is time interval (in months) between two succession population estimates, N-sub-1 and N-sub-2, were 0.36 for July-August, and 1.56 for August-September. Similar estimates for gizzard shad were 1.90 and 2.95. Standing crops of both shad in Beaver Reservoir were estimated respectively at 10.1 and 21.3 kilograms/hectare for July, 19.1 and 4.5 for August, and 7.8 and 0.4 for September (converted from lbs/acre). (Voigtlander-Wisconsin)
W70-05382

REFLECTIONS ON WATER,
Minnetonka Herald, Minn.
Hibbert Hill.
Northern States Power Company, Minneapolis, Minnesota, 95 p, 1968. 2 fig, 2 tab.

Descriptors: *Lakes, *Ponds, *Algae, *Plankton, *Ecology, Limnology, Thermal properties, Mudwater interfaces, Algae, Aquatic animals, Seasonal, Spawning, Pondweeds.
Identifiers: *Christmas Lake (Minn), Wild celery, Hydra, Pediastrum, Closterium, Euglena, Volvox, Oscillatoria, Spirogyra, Vorticella, Anabaena flos aquae, Blue-green algae.

Amateur naturalists can make important contributions to knowledge of eutrophication. Lakes, which are an integral part of our landscape are not merely summer or winter playgrounds, but objects worthy of scientific study. 'Reflections on Water' is a compilation of essays, originally published as a weekly column in the Minnetonka Herald (Minnesota). Although the author has an engineering background, there is nothing amateurish in his study approach or description of Christmas Lake, Minnesota. The aquatic biology of the lake was studied in detail and followed for a year of its life cycle. Temperature changes, plankton, including important algae, fish and other animals, physical limnology, aquatic higher plants, and sediments are described. Many important, yet unresolved, problems are described. This is an entertaining work, but the real value of 'Reflections on Water' lies in its demonstration that enthusiastic, but disciplined laymen can make extremely valuable contributions to understanding environmental problems. (Gerhold-Wisconsin)
W70-05386

ALGAE AND PHOTOSYNTHESIS IN SHAGAWA LAKE, MINNESOTA,
Minnesota Univ., Minneapolis. Limnological Research Center.
Robert O. Megard.
University of Minnesota, Minneapolis, Limnological Research Center, Interim Report No 5, April 1969. 5 fig, 10 tab, 8 ref.

Descriptors: *Algae, *Photosynthesis, *Minnesota, Phytoplankton, Cyanophyta, Diatoms, Stratification, Oxygen, Hydrogen ion concentration, Temperature, Depth, Density, Chlorophyll, Ice, Seasonal, Diurnal, Light intensity, Carbon, Sewage treatment, Tertiary treatment, Effluents, Limnology, Water chemistry, Respiration, Bathymetry, Salinity, Phosphorus, Productivity, Chlorophyta, Chrysophyta, Scenedesmus, Standing crop.
Identifiers: *Shagawa Lake (Minn), Aphanizomenon flos aquae, Stephanodiscus astrea, Lake Minnetonka (Minn), Morphometry, Algae blooms, Clearwater Lake (Minn), Trout Lake (Minn), Kimball Lake (Minn), Cryptophyta, Pyrophyta, Chroomonas acuta, Schroederia setigera, Melosira ambigua, Ceratium hirudinella, Ankistrodesmus, Glenodinium pulvisculus, Scenedesmus quadricauda.

Shagawa Lake (Minnesota) phytoplankton was dominated by Aphanizomenon flos aquae in summer and Stephanodiscus astrea var minutula in winter, mainly concentrated in depths above 4 meters. Chlorophyll content of Aphanizomenon filaments in different parts at the lake surface were similar on any date but decreased 40% in two weeks, a possible response to recent photic history or population aging. Chlorophyll concentrations and algal densities beneath March ice were greater than in some parts of the lake during summer. When algae from different localities were incubated at 0.5 meter depth (light intensities optimal for photosynthesis on sunny days), average daily rate of photosynthetic carbon assimilation was 42 micrograms carbon/microgram chlorophyll, identical to the rate at the same temperature in Lake Minnetonka. The dense algal populations in surface waters absorbed so much light that there was little photosynthesis below 3 meters. Algal photosynthetic capacity beneath almost one meter clear ice nearly equalled that of cloudy summer days. Effects of algal photosynthetic capacity were measured on varying amounts of effluent from secondary and tertiary waste treatment plants. Photosynthesis was stimulated slightly by tertiary effluent, but halted by 20% municipal water. (See also W69-00659, W69-10167). (Jones-Wisconsin)
W70-05387

MEASUREMENTS OF EUTROPHICATION AND TRENDS,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05C.
W70-05394

ON THE VARIATION IN BOTTOM FAUNA AND FISH YIELD IN RELATION TO TROPHIC LEVEL AND LAKE DIMENSIONS,
Dalhousie Univ., Halifax (Nova Scotia).
F. R. Hayes.
Journal Fisheries Research Board of Canada, Vol 14, No 1, p 1-32, 1957. 6 fig, 8 tab, 95 ref, appendix.

Descriptors: *Lakes, *Depth, *Dimensions, *Trophic level, Fauna, Productivity, Fish populations, Fish, Food chains, Measurement, Dimensional analysis.
Identifiers: *Lake capacity, Canadian lakes productivity, Productivity index, Fish yield.

A study of 500 lakes indicates that up to 0.3 square kilometer lakes have a mean depth of 3 to 4 meters; the depth of larger lakes tends to follow a linear log-log plot relationship. The productivity index was calculated for about 150 lakes by factoring fish records into three trophic levels: short food chain (carp), intermediate (bluegills), and long food chain (trout, bass). This index was inversely proportional to mean depth on a log-log plot. By correction of the productivity index, a theoretical value--the quality index--was derived for a standard lake 5 meters deep. The quality index screens the effect of depth and reveals the inherent capacity of the lake. A survey of bottom fauna in 250 lakes failed to provide a correlation between depth and productivity. (Wilde-Wisconsin)
W70-05397

ON THE THEORY OF ADDING NUTRIENTS TO LAKES WITH THE OBJECT OF INCREASING TROUT PRODUCTION,
Dalhousie Univ., Halifax (Nova Scotia). Zoological Lab.
F. R. Hayes.
Canadian Fish Culturist, Vol 10, p 32-37, 1951. 13 ref.

Descriptors: *Nutrients, *Lakes, *Trout, *Fish management, Fertilization, Algae, Plankton, Nitrogen, Phosphorus, Potassium, Selectivity, Poisons, Oxygen, Tracers, Phosphorus radioisotopes, Ions, Humic acids, Carp, Ice, Iron compounds, Hydrogen ion concentration, Acidity, Mud, Hydrogen sulfide.
Identifiers: Prince Edward Island (Canada), Nova Scotia (Canada), Penguins, Lake Zurich (Switzerland), Whitefish, Punchbowl Lake (Canada).

When nutrient salts are added to lakes for fertilization, 90% may disappear in an exchange reaction, within a few weeks. The remaining 10% is likely to remain in or available to the water contributing to algal growth, leading to animal plankton growth, and thence to fish growth. None of the extra material is probably seen during the second summer. While information is less complete regarding potassium and nitrogen, than phosphorus, the view is that about the same percentage of each would survive in water after equilibration. As a conservation measure, fertilization of lakes does not appear to be an economically feasible procedure, although it constitutes an interesting experiment for a privately controlled lake. If there are no coarse fish to replace trout under high fertility conditions, large trout yields may be expected. This seems the situation in Prince Edward Island. Alternatively coarse fish might be selectively poisoned in conjunction with a fertilization program. Selective poisoning, by removing coarse fish from shallows while leaving trout in the depths, has been found promising. It may be that trout survive where they do, because they can tolerate more adverse conditions than competing fish. (Jones-Wisconsin)
W70-05399

PIGMENTS FROM THE BOTTOM DEPOSITS OF AN ENGLISH LAKE,
University Coll., London (England). Dept. of Botany.
G. E. Fogg, and J. H. Belcher.
New Phytologist, Vol 60, p 129-142, 1961. 8 fig, 22 ref, appendix.

Descriptors: *Sediments, *Lakes, *Pigments, Chlorophyll, Chromotography, Spectrophotometry, Forests.
Identifiers: *Acetone-soluble pigments, Chlorophyll degradation, Deforestation, Carotenes, Lutein, Carotenoids, Esthwaite Water (England), English Lake District.

Chromotographic and spectrophotometric identification of acetone-soluble pigments from the Esthwaite Water sediment revealed that these chlorophyll degradation products are similar to those of North American lakes. The main components of pigments, and beta-carotenes, lutein, and epiphasic carotenoids showed a general correlation with the amount of organic matter at different depths and with the past ecological changes. The ratio of chlorophyll degradation products to epiphasic and hypophasic carotenoids remained constant to the depth of 100 centimeters, but lutein showed a retarded decomposition. The results suggest regular changes of environment from the Boreal period, and a radical alteration of the milieu in about A D 1000, inflicted by deforestation. (Wilde-Wisconsin)
W70-05402

LIMNOLOGICAL RELATIONS OF INDIAN INLAND WATERS WITH SPECIAL REFERENCE TO WATERBLOOMS,
University Coll., London (England). Dept. of Botany.
R. N. Singh.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 12, p 831-836, 1953. 16 ref.

Descriptors: *Limnology, *Water, *Rivers, *Lakes, *Ponds, Light, Temperature, Fertilization, Fish, Nuisance algae, Odor, Taste, Depth, Circulation, Diurnal, Winds, Currents (Water), Water pollution, Drainage, Organic matter, Sewage, Phytoplankton, Productivity, Chlorophyta, Hydrogen ion concentration, Nitrates, Phosphates, Cyanophyta, Oxidation-reduction potential, Bottom sediments, Euglenophyta, Toxicity.
Identifiers: *India, *Blooms, River Ganges (India), Rajghat (India), Bombay (India), Benares (India), Macrophytes, Cladophora, Oedogonia, Spirogyra, Microcystis aeruginosa, Anabaenopsis, Raciborskii, Raphidiopsis, Anabaena, Wollea, Oscillatoria, Spirulina, Volvocales, Glenodinium, Trachelomonas.

Indian waters are infested with water blooms. Experiments with bloom types and their effect on animals proved that Indian water blooms are never toxic although the same algal species are poisonous in other countries. Blue-green algae encourage growth of fish which feed upon them directly or indirectly, providing an excellent source of fertilization of a pond. The bloom can also be utilized as green manure; dried bottom muds are used as a manure source. The algae blooms are initailly saprophytic--significant in view of their sudden appearance after a long absence. In the Ganges, the algal flora is typically Chlorophycean, but a marked change occurs when the river receives sewage or effluent, then a Myxophycean bloom is formed. Samples of algae bloom dried for fertilization of hatchery ponds have been prepared which can be inoculated and grown successfully. A biological method of control by introducing fish and crustaceans for food utilization might be envisaged. When bloom disintegration has reached a maximum and temperature is high, a pond may be covered with dead fishes involving economic loss. (Jones-Wisconsin)
W70-05404

THE EUTROPHICATION OF LAKE KLOPEINER (In German),
Biologische Station Lunz (Austria).
I. Findenegg.
Oesterreichische Wasserwirtschaft, Vol 17, No 7-8, p 175-181, 1965. 4 fig, 3 tab.

Descriptors: *Eutrophication, Temperature stratification, Depth, Plankton, Light penetration, Seasonal, Primary productivity, Calcium, Nitrates, Ammonia, Phosphates, Hydrogen ion concentration, Phytoplankton, Odor, Winds, Epilimnion, Hypolimnion, Light intensity, Conductivity, Algae, Sewage, Diatoms, Cyanophyta, Carbon radioisotopes, Potassium, Oxygen.
Identifiers: *Lake Klopeiner (Austria), Lake Worther (Austria), Vertical, Chalk, Metalimnion, Oscillatoria rubescens, Dinobryon, Uroglena americana, Cyclotella, Ceratium hirundinella, Peridinium willei, Chlorococcales, Ankistrodesmus, Oocystis, Cryomonas erosa, Cosmarium, Chrococcus limneticus, Lyngbya limnetica, Anabaena flos aquae, Tabellaria, Melosira, Fragilaria crotonensis, Aphanizomenon.

Lake Klopeiner, Austria, despite heavy sewage influx, has not progressed far in eutrophication, although considerable amounts of nutrients have accumulated in the depths as a result of meromixis. This meromictic behavior is the key to understanding the stratification of oxygen and its changes since 1931. The zone free of oxygen expanded upward during the course of the decades and lay between 20 and 35 meters in 1935 and is now elevated to a level between 10-25 meters. This meromictic behavior in winter and the strict separation of both epi- and hypolimnion in summer give a special character to the course of eutrophication. The lake has an unusual thermic position: seldom disturbed by winds and then only for short periods, it has no strong currents; local breezes distribute the surface water, warmed by sunshine, only within a thin layer of epilimnion. An increase in amount of algae is due to the immigration of a species of plankton, the blood alga (Oscillatoria rubescens), not observed before. This species is regarded as an indicator of increasing eutrophication accelerated by domestic sewage. There is also a decrease of transparency. (Jones-Wisconsin)
W70-05405

THE ECOLOGICAL SIGNIFICANCE OF CLADOCERAN REMAINS IN LAKE SEDIMENTS,
Indiana Univ., Bloomington. Dept. of Zoology.
David G. Frey.
Ecology, Vol 41, No 4, p 684-699, 1960. 30 fig, 7 tab, 58 ref.

Descriptors: *Lakes, *Sediments, Biomass, Plankton, Nitrogen (Organic).
Identifiers: Cladocerans, Lake Ontogeny, Madison lakes (Wis).

This study of cladoceran remains in sediments of Madison lakes (Wisconsin) recovered nearly all previously reported species and disclosed six new ones. The four lakes studied show a regular gradation of the total population densities of remains correlated with the mean biomass of plankton and organic nitrogen content. A decrease in size and depth of the lake corresponds to a lower density of Daphnia and a higher abundance of Bosmina and non-planktonic Chydorus spp. (Wilde-Wisconsin)
W70-05406

THE WATERS OF MEROM: A STUDY OF LAKE HULEH. I. INTRODUCTION AND GENERAL STRATIGRAPHY OF A 54 M CORE,
Pittsburgh Univ., Pa. Dept. of Biology.
Ursula M. Cowgill.
Archiv fur Hydrobiologie, Vol 66, No 3, p 249-272, 1969. 9 fig, 1 tab, 28 ref.

Descriptors: *Lakes, *Cores, Sedimentation rates, History, Peat, Maps, Geological surveys, Vegetation.
Identifiers: Carbon-14 analysis, Lake Huleh (Israel), Jordan Valley, Waters of Merom (Israel), Israel.

This study of a 54-meter core, drilled in the center of drained Lake Huleh in the Jordan Valley, Israel, revealed the previous existence of a swamp which was later converted into a lake, presumably by damming the Jordan River. According to carbon-14 analyses, the alteration took place some 30,000 years ago. The distribution of macroscopic plant remains and shells suggests a prevalence of limnetic conditions during the deposition of the sediment 20-25 meters below the present surface. The surface 7 meters of the sediment were deposited during historic times. The low sedimentation rate of only 0.034 centimeter/year rose to 0.45 centimeter/year some 8,000 to 9,000 years ago, and then fell to about 0.16 centimeter/year over the past two-and-one-half millenia. (Wilde-Wisconsin)
W70-05407

THE DYSTROPHIC LAKE TYPE,
Copenhagen Univ. (Denmark). Geographical Lab.
Kaj Hansen.
Hydrobiologia, Vol 19, p 183-191, 1962. 30 ref.

Descriptors: *Lakes, *Dystrophy, Acidity, Humus, Sediments, Soil types, Swamps, Peat.
Identifiers: Carbon:nitrogen ratio, Dy sediments, Tyrfopel sediments, Oligohumus, Euhumus.

The identifying characteristics of dystrophic lakes of either oligotrophic or eutrophic nature include the presence of acid humus in water and in the sediment, carbon:nitrogen ratio exceeding 10, and an excess of production of organic matter over its decomposition. The sediments are of dy or tyrfopel, rather than gyttja type. An increase in the content of acid humus is paralleled by changes in composition of plant and animal communities. In advanced stages of development, dystrophic lakes are replaced by peat deposits. (Wilde-Wisconsin)
W70-05408

ENVIRONMENTAL REQUIREMENTS OF FRESH-WATER PLANKTON ALGAE,
Uppsala Univ. (Sweden). Inst. for Physiological Botany.
Wilhelm Rodhe.
Symbolae Botanicae Upsalienses, Vol 10, No 1, p 1-149, 1948. 33 fig, 30 tab, 96 ref.

Descriptors: *Environment, *Fresh water, *Plankton, *Algae, Scenedesmus, Light, Cultures, Iron compounds, Diatoms, Cyanophyta, Phosphates, Chlorophyll, Magnesium, Potassium, Temperature, Epilimnion, Light intensity, Seasonal, Physiological ecology, Ecotypes, Chlorophyta, Photometry, Chlorella, Nutrients, Trace elements, Chlamydomonas, Chrysophyta, Nitrates, Plant growth, Bicarbonates, Depth.
Identifiers: *Requirements, Scenedesmus, Absorption, Cell concentration, Uroglena, Ankistrodesmus, Chlorococcales, Volvocales, Conjugatae, Heterokontae, Gloeotrichia, Asterionella, Dinobryon, Melosira, Aneboda (Sweden), Uppsala (Sweden), Lake Erken (Sweden), Extinction values, Eudorina, Culture medium, Coelastrum, Pediastrum.

This work elucidates the influence of some environmental factors on freshwater plankton algae. The requirements of some algae, especially Scenedesmus quadricauda, were studied in cultures under controlled conditions and compared with lake conditions. Substance production, cell multiplication, and chlorophyll formation are rather independent aspects of the development of a culture. Parallel determinations should be carried out for the different parameters. Alpha a-dipyridyl and o-phenanthroline are sensitive and reliable reagents for determination of iron in water. In light, one part critric acid to one part ferric citrate has a stabilizing effect sufficient for algal cultures. A culture solution was composed suitable for unlimited cultivation of about 40 species and forms belonging to Chlorococcales, Volvocales, Conjugatae, Heterokontae, and diatoms. The phosphate dependence of growth can differ for various plankton algae. Experimental results with Dinobryon and Uroglena suggest that phosphorus, even in ordinary lakes, may become a maximum factor for some algae; ecological observations confirm this suggestion. The competition of algae for available nitrogen ions is a factor in natural conditions with different algal densities. In average lakes magnesium and potassium never limit the development of Scenedesmus quadricauda. Melosira islandica ssp helvetica prefers low temperatures; Ankistrodesmus falcatus higher temperatures. (Jones-Wisconsin)
W70-05409

RESERVOIR AUFWUCHS ON INUNDATED TREES,
Wisconsin State Univ., La Crosse. Dept. of Biology.
Thomas O. Claflin.
Transactions of the American Microscopical Society, Vol 87, No 1, p 97-104, 1968. 4 fig, 6 ref.

Descriptors: *Periphyton, *Reservoirs, Biomass, Flow, Water level fluctuation, Midges, Missouri River, Benthic fauna, Standing crop.
Identifiers: *Aufwuchs, Tendipedidae, Lewis and Clark Lake (S D-Neb), Lake Francis Case (S D), Midge larvae, Macrofauna.

Periphyton standing crop in Lewis and Clark Lake Reservoir, bordered by South Dakota-Nebraska, was greatest in May of 1964 and 1965, decreased

rapidly in June and July, then increased slightly in August and fell to low levels during periods of ice cover. Cell counts varied from more than 10 million cells/square centimeter of substrate in May to less than 100 thousand cells during ice cover. Standing crops in Lake Francis Case (South Dakota) reached later peaks due to more extreme water level fluctuations; maxima were observed in July. Tendepid larvae and pupae were most numerous groups associated with periphyton, reaching densities of 10,500 larvae and 4800 pupae per square meter of substrate. Standing crops of periphyton were much greater in Lewis and Clark Lake as based on total pigment analysis. Water level fluctuations in Lake Francis Case will probably preculde estiblishment of a vigorous periphyton community. (Voigtlander-Wisconsin)
W70-05410

NUTRIENT REMOVAL A UNIVERSAL REQUIREMENT,
Roger Davies.
Water and Pollution Control, p 28-30, January 1970. 1 fig.

Descriptors: *Nutrients, International Joint Commission, Lake Erie, Lake Ontario, Water pollution, Eutrophication, St Lawrence River, Oligotrophy, Turbidity, Productivity, Phytoplankton, Phosphorus, Nitrogen, Detergents, Industrial wastes, Municipal wastes, Retention, Sedimentation, Cyanophyta, Nitrogen fixation, Sewage treatment, Effluents, Drainage, Agricultural watersheds, Coliforms, Michigan, Ohio, New York, Storm drains, Viruses, Herbicides, Pesticides, Oil wastes, Gasoline, Drilling, Cost analysis.
Identifiers: *Removal, *Requirement, Mesotrophic, Canada, Detroit (Mich), Toledo (Ohio), Cleveland (Ohio), Buffalo (N Y), Niagara River (N Y), Oshawa (Canada), Standby equipment, Public.

This review of the International Joint Commission findings on pollution of Lakes Erie and Ontario and the St Lawrence River international section recommends complete replacement of phosphorus compounds in detergents and phosphorus reduction in municipal and industrial wastes with nitrogen reduction to follow. Partial replacement of phosphates in detergents is possible with no reduction in cleansing efficiency. An environmentally harmless substitute for full replacement of phosphates might be found. If phosphates were replaced in detergents, removal of 80% of remaining phosphorus at sewage treatment plants would reduce the concentration to 0.6 milligrams/liter. Further reductions in lakes are possible by preventing land drainage. Anti-pollution recommendations include: standby equipment to take over during breakdowns, inadequate performance, or overflows; separation of storm and sanitary sewage collection systems; avoidance of bypassing untreated wastes; intensification of viral research; requirement that organizations, planning thermal powerplants, submit plans to pollution control agencies; banning unconfined open lake dumping; implementation of herbicides and pesticides controls; recognition that oil and gas drilling are potential pollution sources; maintenance of adequate water quality monitoring. Success of the proposals depends upon willingness of the public to pay increased control costs. (Jones-Wisconsin)
W70-05412

THE AGING GREAT LAKES,
Charles F. Powers, and Andrew Robertson.
Scientific American, Vol 215, No 5, p 94-100, 102, 104, 1966. 8 fig.

Descriptors: *Eutrophication, *Great Lakes, *Lake Erie, Lake Huron, Fish, Fish populations, Bass, Herring, Walleye, Pikes, Lampreys, Carp, Trout, Commercial fishing, Perches, Industrial wastes, Wastes.
Identifiers: Detroit River, Cattaraugus Creek (N Y), Alewife, Suckers.

A general physical and geographical look at the Great Lakes together with some ecological changes that have occurred because of man's activities are presented. Natural aging aspects of the Lakes versus accelerated aging (eutrophication) are compared. One of the first instances of man's catastrophic effects on the natural resources followed the building of the Welland Canal, which allowed the sea lamprey and alewife to penetrate around Niagara Falls into the inner lakes. By the 1950's the alewife had killed off nearly all the lake trout and burbot in Lakes Huron, Michigan and Superior. The alewife has become prominent and threatens to change the ecological balance by feeding on the eggs of more desirable species. The coho salmon experiment in Lakes Michigan and Superior, to reduce the alewife population is briefly discussed. Ecological alterations that will occur as the result of pollution will be more profound. Industrial and municipal pollutants that are discharged into Lake Erie and their effect on commercial fishing are drastic. Between 1956 and 1965 catches of blue pike, walleye, lake herring, whitefish, and sauger declined while catches of undesirable species rose. (Haskins-Wisconsin)
W70-05415

THE PHYTOPLANKTON OF SOME IRISH LOUGHS AND AN ASSESSMENT OF THEIR TROPHIC STATUS,
Bristol Univ. (England). Dept. of Botany.
F. E. Round, and A. J. Brook.
Proceedings of the Royal Irish Academy, Vol 60, Sect B, p 167-191, 1959. 8 fig, 8 tab, 14 ref.

Descriptors: *Lakes, *Phytoplankton, *Littoral, Trophic level, Drainage, Eutrophication, Distribution, Sampling.
Identifiers: Bacillariophyceae, Chrysophyceae, Chrysospherinae, Cyanophyceae, Desmidae, Nygaard's compound index, Irish loughs, Morphological deviation, Ireland.

Phytoplankton was collected in early September with a 180-mesh/inch net from the margins of 26 loughs. Effort was made to avoid contamination of samples with benthic algae, The water basins were classified into oligotrophic, mesotrophic, and eutrophic on the basis of drainage influence and Nygaard's compound index. A general record of the distribution of taxa was supplemented by calculation of the phytoplankton quotients, ranging from 0.19 for oligotrophic to 21.0 for eutrophic basins. The results indicated a predominance of Desmids in oligotrophic loughs and Chlorococcales in eutrophic waters. Myxophyceae and Centric diatoms exhibited pronounced tropic preferences and may serve as indicators of eutrophication status. A comprehensive description of taxonomic contents of investigated basins is provided, as well as deviational forms of some organisms. (Wilde-Wisconsin)
W70-05416

PHOSPHATE FERTILIZATION OF PONDS,
Alabama Agricultural Experiment Station, Auburn.
H. S. Swingle, B. C. Gooch, and H. R. Rabanal.
Proceedings of the 17th Annual Conference, Southeastern Association of Game and Fish Commissioners, held at Hot Springs, Arkansas, September 29-October 2, p 213-218, 1963. 1 tab, 14 ref.

Descriptors: *Ponds, *Fertilization, *Phosphate, Fish, Plankton, Aquatic weed control, Insect control, Mosquitos, Algal control, Bass, Carp, Catfishes, Nitrogen, Potassium.
Identifiers: Phosphate fertilizers, Bluegills, Microcystis scums, Pithiophora algae.

Reinforcement of phosphate fertilization of fish ponds with nitrogen and potassium produced no significant increase in the biomass of plankton or fish yield. In ponds previously treated with 8-8-2 fertilizer, Microcystis scums continued to be a problem even when fertilization was limited to phosphates. In some instances, application of phosphate fertilizers alone delayed response for 30 to 60 days and permitted the growth of Pithophora algae. (Wilde-Wisconsin)
W70-05417

STANDING CROPS OF DISSOLVED ORGANIC MATTER, PLANKTON, AND SESTON IN A NEW AND AN OLD OZARK RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
Richard L. Applegate, and James W. Mullan.
Reservoir Fishery Resources Symposium, Athens, Georgia, April 5-7, p 517-530, 1967. 8 fig, 5 tab, 14 ref.

Descriptors: *Standing crop, *Plankton, *Organic matter, *Reservoirs, Arkansas, Missouri, Seston, Phytoplankton, Zooplankton, Daphnia, Succession, Decomposing organic matter.
Identifiers: Nannoseston, Beaver Reservoir (Ark-Mo), Bull Shoals Reservoir (Ark-Mo), Daphnia galeata mendotae, White River (Ark-Mo).

Standing crops of dissolved organic matter, plankton and seston were compared for 12-15 year old Bull Shoals Reservoir and newly-impounded Beaver Reservoir on the White River. Concentration of dissolved organic matter in Beaver has inclined downward since impoundment, from 7.2 to 5.0 milligram/liter (mean, 5.8); mean for Bull Shoals is 6.2 mg/l. Beaver showed greater ranges of nannoseston and net seston and a greater mean of nannoseston (1.24 vs 1.03 mg/l as compared with Bull Shoals, while Bull Shoals showed a greater mean concentration of net seston (44.4 vs 32.6 mg/l for Beaver). Diatoms dominated phytoplankton of both reservoirs. Blue-green algae were of secondary importance in Beaver, yellow-green algae occupied a secondary position in Bull Shoals. Seasonal estimates of zooplankton standing crop showed a unimodal curve for Bull Shoals and a bimodal curve for Beaver. Rapid species succession in phytoplankton and zooplankton is taking place in Beaver, with larger species replacing smaller species. Daphnia galeata mendotae has replaced smaller daphnids. Mean annual amounts of items studied did not differ significantly between reservoirs; differences related primarily to sequences of abundance. (Voigtlander-Wisconsin)
W70-05421

SOME ENVIRONMENTAL FACTORS INFLUENCING BENTHIC INVERTEBRATES IN TWO MISSOURI RIVER RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak.
Bruce C. Cowell, and Patrick L. Hudson.
Reservoir Fishery Resources Symposium, April 5-7, 1967, Athens, Georgia, p 541-555, Nov 1968. 4 fig, 4 tab, 10 ref.

Descriptors: *Benthic fauna, *Invertebrates, *Missouri River, *Reservoirs, Temperature, Dissolved oxygen, Periphyton, Water levels, Waves (Water), Depth, Population.
Identifiers: Substrate, Morphometry, Lewis and Clark Lake (S. Dak), Lake Francis Case (S. Dak), Hexagenia, Chironomid larvae.

A smaller, shallow reservoir on the Missouri River (Lewis and Clark Lake) was compared with larger, deeper Lake Francis Case to determine factors influencing benthic invertebrate populations. Temperature was the major factor in controlling life cycle duration of Hexagenia. Substrate type appeared limiting only in areas containing high percentages of sand. Hexagenia nymphs apparently migrate from deeper channel areas during periods of low oxygen concentration. Swift currents and heavy wave action produce substrate types unsuitable for Hexagenia and chironomids. Migration of Hexagenia nymphs is nocturnal and may be initiated by increasing temperature, water level fluctuation and population densities. Estimates of Hexagenia loss from Lewis and Clark Lake (mid-April to early July) amount to 170 million nymphs or

24.1 metric tons, about 10% of the spring standing crop. Similar estimates of total chironomids and ceratopogonids loss amounted to 20 metric tons. Benthic invertebrates appear on inundated trees and aquatic plants immediately after onset of periphyton growth; densities of benthic fauna in periphyton were significantly higher than for adjacent bottom areas. (Voigtlander-Wisconsin)
W70-05422

CHEMICAL CHARACTERISTICS OF SOUTH-CENTRAL LAKE HURON,
Bureau of Commercial Fisheries, Ann Arbor, Mich.
Herbert E. Allen.
Michigan Univ, Ann Arbor, Great Lakes Research Division, Publication No 11, p 45-53, 1964. 2 fig, 2 tab, 8 ref.

Descriptors: *Lake Huron, *Chemical properties, *Chemical analysis, Temperature, Hydrogen ion concentration, Conductivity, Calcium, Potassium, Sodium, Chlorides, Sulfates, Silica, Currents (Water).
Identifiers: Saginaw Bay.

Water samples for chemical analysis were collected from south-central Lake Huron between June and November, 1956. Data is based on 233 samples taken from stations at the mouth of Saginaw Bay and along a transect from Harbor Beach, Michigan, to Goderich, Ontario. Median values were chosen to represent the usual composition of the lake since average values were influenced by water outflow from Saginaw Bay. Medium values for the eight cruises were: sodium, 2.54 ppm; potassium, 0.85 ppm; calcium, 26.7 ppm; chloride, 5.9 ppm; sulfate, 13 ppm; silica 1.9 ppm; and conductivity 174 micro-ohms at 18C. Median values for all chemicals, with the exception of silica, were higher at the surface than in subsurface samples although differences were slight. Above median concentrations were obtained most frequently for sodium, calcium, chloride, and conductivity, attributable to Saginaw Bay water outflow and substantiated by current patterns evaluated by drift bottles released during three cruises. Results, with the exception of calcium (2-3 ppm higher) and silica, agreed with previously published data. The reason for differences in calcium results were unknown. Seasonal and depth differences in silica concentrations were attributed to its incorporation by diatoms. (Haskins-Wisconsin)
W70-05423

CELL METHOD FOR COMPUTING LAKE CIRCULATION,
Cornell Univ., Ithaca, N.Y. School of Civil Engineering.
James A. Liggett.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY3, Paper 7152, p 725-743, March 1970. 19 p, 13 fig, 4 ref, append.

Descriptors: *Lakes, *Water circulation, *Mathematical models, *Computer programs, Flow, Hydraulics, Coriolis force, Path of pollutants, Winds, Turbulent flow, Topography, Eddies, Limnology.
Identifiers: Eddy viscosity, Lake circulation.

The equations of fluid motion are solved using finite differences for the three-dimensional, wind-driven circulation in a homogeneous lake of arbitrary bottom topography. The method allows arbitrary choices for the wind stress, the horizontal and vertical eddy viscosities, and the distribution of vertical eddy viscosity. For the examples investigated the nonlinear terms of the equations contributed little or nothing, indicating that lake circulation is well described by linear equations. The magnitudes of the horizontal and vertical eddy viscosities have a strong effect on the current velocity but only a minor effect on the circulation patterns. The distribution of the vertical eddy viscosity appears to play a minor role in the circulation pattern. Sample calculations indicate that some combinations of horizontal eddy viscosity, vertical eddy viscosity, and distribution of vertical eddy viscosity are nearly equivalent in that these combinations produce similar response curves, similar current velocities and circulation patterns having small differences. (Knapp-USGS)
W70-05482

2I. Water in Plants

PHYSIOLOGICAL RESPONSE OF PLANTS TO SALINITY AND HUMIDITY,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
James W. O'Leary, and James J. Riley.
Available from the Clearinghouse as PB-190 484, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report, (1970). 13 p, 3 tab, 1 fig. A-016-ARIZ.

Descriptors: *Plant physiology, *Salt tolerance, *Saline water, Plant growth.

Red kidney bean (Phaseolus vulgaris L.) plants were grown in nutrient solutions in conventional greenhouses (relative humidity 40-50%) and closed system greenhouses (relative humidity 85-95%). Some of the solutions were salinized with 5600 ppm NaCl. During the winter the beneficial effect of high humidity on bean yield was excellent, the salt-treated plants yielding almost four times the dry weight of beans as the salt-treated plants in the conventional greenhouses. In fact, the yield from the salt-treated plants in the high humidity was about 90% of the yield from the control plants in the conventional greenhouse. It is concluded that there is considerable promise of being able to use brackish water for a highly salt sensitive crop such as red kidney beans when they are grown in a high humidity environment. For more salt tolerant plants, the potential should be even greater.
W70-05119

AQUATIC WEEDS,
Wisconsin Univ., Madison; and Agricultural Research Service, Fort Lauderdale, Fla.
L. G. Holm, L. W. Weldon, and R. D. Blackburn.
Science, Vol 166, No 3906, p 699-709, Nov, 1969. 11 p, 10 fig, 29 ref.

Descriptors: *Aquatic environment, Aquatic plants, Environment, Lakes, *Aquatic weed control, *Aquatic weeds, *Ecology, *Environmental effects, Limnology, Biology, Biocontrol, Herbicides, Mechanical control, Streams, Rivers, Reservoirs, Water pollution, Water quality, Phreatophytes, Water resources, Water hyacinth, Bibliographies.
Identifiers: Submersed weeds, Emersed weeds, Floating weeds.

In converting virgin land to intensified farming and altering watercourses with dams and reservoirs, the balance of nature is upset and new species of weeds, rodents, insects, and diseases appear where they did not exist before. Several explosions of aquatic weeds in the great rivers and lakes of the warm regions of the world have forced us to recognize the power of such infestations. Aquatic weeds destroy fisheries, obstruct waterflow, prevent recreation, increase evaporation, stop navigation, cause large losses of water through increased evaporation and transpiration, depress real estate values, present health hazards, and interfere with hydroelectric and irrigation schemes. The rapid growth of weed infestations has been spectacular and frightening, and has made us aware that something is wrong. Problems produced by infestations of water hyacinth, salvina, water lettuce, submersed weeds, emersed weeds, phreatophytes, and floating island weeds are discussed. Chemical, biological, and mechanical methods for aquatic weed control are described. Streams and lakes are not self-cleansing bodies; the tools for restoration can be found in combinations of chemical, biological, and mechanical control. (USBR)
W70-05215

SPECIES-SOIL RELATIONSHIPS ON THE GREAT SALT PLAINS OF NORTHERN OKLAHOMA,
Ohio Univ., Athens. Dept. of Botany.
Irwin A. Ungar.
American Midland Naturalist, Vol 80, No 2, p 392-406, October 1968. 3 fig, 7 tab, 22 ref.

Descriptors: *Halophytes, *Salt tolerance, *Saline soils, *Salinity, *Vegetation, Oklahoma, Rainfall, Soil moisture, Soil texture, Chlorides, Hydrogen ion concentration, Conductivity, Soil-water-plant relationships, Sands, Seeds, Dunes, Germination, Organic matter, Plant communities.
Identifiers: *Great Salt Plains, *Indicator species, Salt pans.

The Great Salt Plains of Alfalfa County, Oklahoma, is a 32,000-acre area of highly saline soils. Vegetation of the region was analyzed quantitatively in an attempt to discover the salt tolerance of species and the effects of salinity on their density and frequency. The analyzed species appear to be indicative of varying degrees of soil salinity and can be used as indicators. While the lower limit of soil salinity for halophytic vegetation is within the range in which nonhalophytes survive, it is toward the upper limit of salt tolerance that the halophytes invade the Salt Plains. Interrelationships of seasonal rainfall, soil moisture, salinity, and conductivity of soil solutions are shown. (Carr-Arizona)
W70-05287

STRUCTURE AND ASSOCIATION IN THE MULGA (ACACIA ANEURA) LANDS OF SOUTH-WESTERN QUEENSLAND,
Charleville Pastoral Lab. (Australia).
W. H. Burrows, and I. F. Beale.
Australian Journal of Botany, Vol 17, No 3, p 539-552, December 1969. 2 fig, 4 tab, 16 ref, 1 append.

Descriptors: *Semiarid climates, *Biological communities, *Ecological distribution, *Data collections, *Desert plants, Droughts, Moisture stress, Arid lands, Analytical techniques, Environmental gradient, Biogeography, On-site data collections, Distribution patterns, Vegetation effects, Surveys.
Identifiers: *Australia, *Queensland, *Microtopography, *Mulga, Association analysis, Mosaics.

The primary purpose of this botanical survey was to record the occurrence of species and to interpret species and community relationships in a long-range study of vegetation change in semiarid southwestern Queensland. Woody vegetation was recorded along two permanently located 20-mile belt transects and the data were interpreted by association analysis. Several site groups were recognized, their location depending on their elevation between the mesic flats and the xeric ridges. The vegetation at both sites represents small mosaics. At the Tobermory site the density of young mulga is not considered adequate for future drought reserves. The survey revealed that in this semiarid environment very large-scale vegetation groups have a very small-scale structure which is based on microtopography. The results of this study should be useful in a fuller utilization of arid zone resources in Queensland. (Carr-Arizona)
W70-05289

DESIGN FEATURES OF INTACT LEAF THERMOCOUPLE PSYCHROMETERS FOR MEASURING WATER POTENTIAL,
Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.; Agricultural Research Service, Riverside, Calif. Salinity Lab.; and Army Electronics Command, Fort Huachuca, Ariz. Research Div.
G. J. Hoffman, and W. N. Herkelrath.
American Society of Agricultural Engineers, Transactions, Vol 11, No 5, p 631-634, September-October 1968. 4 fig, 2 tab, 11 ref.

Descriptors: *Soil-water-plant relationships, *Hygrometry, *Leaves, *Instrumentation, *Measurement, Isotherms, Air temperature, Sealants, Calibrations.

Identifiers: *Water potential, *Thermocouple psychrometers.

Although it would be preferable to measure the water potential of components of the plant-soil system under field conditions, such measurements are usually made on detached leaf samples under isothermal conditions. Now a miniature thermocouple psychrometer has been developed to measure water potential of intact leaves. While designed to minimize interference with leaf metabolic processes, miniaturization of the probe did not affect the water potential readings. The study also revealed that the best sealant with which to attach the probe to leaves was a silver-impregnated, water-based conductive paint. (Carr-Arizona)
W70-05294

TRANSPIRATION INTENSITY AS RELATED TO VEGETATION ZONATION IN THE WHITE MOUNTAINS OF CALIFORNIA,
California Univ., Los Angeles. Dept. of Botanical Sciences.
For primary bibliographic entry see Field 02D.
W70-05299

THE MOLECULAR NATURE OF ORGANIC MATTER IN LAKES AND OCEANS, WITH LESSER REFERENCE TO SEWAGE AND TERRESTRIAL SOILS,
Queen's Univ., Kingston (Ontario).
J. R. Vallentyne.
Journal Fisheries Research Board of Canada, Vol 14, No 1, p 33-82, 1957. 3 tab, 343 ref.

Descriptors: *Molecular structure, Water structure, Soil chemistry, Organic matter, Soil properties, Sewage, Ions, Analysis, Distillation, Lakes, Oceans, Soils, Chromatography, Activated sludge.
Identifiers: *Toxic plankton, Microcystis, Gleotrichia, Gonyaulax, Prymnesium.

The essential, often overlooked detail of studies related to biochemical ecology is that organisms respond to the molecular configuration of atoms rather than atoms themselves. Recent developments of chromatographic analyses permit now identification of minute amounts of specific organic compounds even when they are present in complex mixtures. This report is concerned with isolation and identification of organic compounds found in seston, humus-enriched water, sediments of lakes and oceans, soils, sewage, and activated sludge. The composition of these media includes carbohydrates, proteinaceous and miscellaneous nitrogen compounds, fats, waxes, alcohols, aldehydes, lignins, chlorophyll, carotenoids, sterids, non-carotenoid hydrocarbons, and vitamins, enzymes, excretions of toxic plankton, and partially characterized compounds. The number of adequately identified compounds in each of the sources is: seston - 45, water - 15, sewage - 14, aquatic sediments - 62, soils - 76. Proximate analyses of organic matter and the determination of 'humins,' 'ulmins,' 'crenic,' 'apocrenic' acids, and the like enigmatic fractions of different solubility are of questionable significance. (Wilde-Wisconsin)
W70-05395

2J. Erosion and Sedimentation

RIVER CHANNEL PATTERNS,
Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 02E.
W70-05065

CORRELATION BETWEEN THE QUANTITY OF BED LOAD AND SUSPENDED LOAD IN RIVERS,
Polish Hydrological Service, Warsaw.
Walenty Jarocki.
Available from Clearinghouse as TT-66-57039, for $3.00 in paper copy, $0.65 in microfiche. Published for Dept of Interior and Nat Sci Found, Washington, D C, by Central Institute for Sci, Tech, and Econ Inf, Warsaw, Poland. Archiwum Hydrotechniki, Vol 14, No 4, pp 535-570, 1967. 36 p, 13 fig, 14 tab, 21 ref.

Descriptors: *Bed load, *Suspended load, *Sediment transport, *Rivers, Sedimentology, Statistical methods, Sampling, Hydraulics, Streamflow, Suspension, Sediment discharge, Sediment distribution, Particle size, Discharge (Water).
Identifiers: Poland.

The radio of bed load to suspended load in rivers was studied by extrapolating mean annual load values from mean monthly and annual water-discharge to sediment-discharge relations, by empirical formulas, and by suspended load sampling programs in Polish rivers. It was found that bed load is always smaller than suspended load at any one place and time. The correlation between quantity of load and the ratio of bed to suspended load ($K = W/U$) is good, with a mean value of 0.022 for K. The value of K tends to decrease as the discharge (Q) increases. The effects of velocity, water level slope, and bed load particle size are difficult to evaluate. (Knapp-USGS)
W70-05082

INFLUENCES OF NORWEGIAN SEA OVERFLOW WATER ON SEDIMENTATION IN THE NORTHERN NORTH ATLANTIC AND LABRADOR SEA,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
E. J. W. Jones, M. Ewing, J. I. Ewing, and S. L. Eittreim.
Journal of Geophysical Research, Vol 75, No 9, p 1655-1680, March 20, 1970. 26 p, 18 fig, 64 ref. ONR Contract N00014-67-A-018-0004.

Descriptors: *Sedimentation, *Oceans, *Oceanography, Seismic studies, Sounding, Hydrography, Bottom sediments, Ocean currents, Density currents, Turbidity currents, Ocean circulation.
Identifiers: Labrador basin, Norwegian Sea.

Reflection profiles and hydrographic data indicate that sedimentation in parts of the northernmost Atlantic and in the Labrador basin has been largely governed by the movement of bottom water derived from the Norwegian Sea. Seismic profiles from the Labrador basin reveal a well-defined body of thick sediments trending NNW on a portion of the continental rise of southern Greeland where turbidity currents cannot reach. The thick sediments lie in a region in which the flow of deep water is weak and in which rapid deposition from sediment-laden bottom waters is allowed. Appreciably stronger bottom currents associated with the counterclockwise circulation of dense water derived from the Norwegian Sea appear to have greatly inhibited deposition of pelagic material in the area surrounding the sediment body. Sedimentation under the influence of bottom currents in this region, in the Rockall area, and on the Blake-Bahama outer ridge took place throughout a large part of Tertiary time but did not occur in the Upper Cretaceous. This is attributed to a major alteration in the circulation pattern of the North Atlantic caused by continental drift, polar wandering, and climatic deterioration between late Cretaceous and late Eocene times. (Knapp-USGS)
W70-05131

SETTLING VELOCITIES AND VERTICAL DIFFUSION OF PARTICLES IN TURBULENT WATER,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
Stephen P. Murray.
Journal of Geophysical Research, Vol 75, No 9, p 1647-1654, March 20, 1970. 8 p, 7 fig, 1 tab, 16 ref. ONR Contract Nonr 1575 (03), NR 388002.

Descriptors: *Settling velocity, *Turbulent flow, Sands, Turbulence, Particle size, Particle shape, Sedimentation, Sedimentology, Model studies, Mathematical studies, Laboratory tests, Diffusion, Sampling, Sedimentation rates, Path of pollutants.
Identifiers: Particle diffusion.

A turbulent flow field that permits study of the kinematics of individual suspended particles was produced in the laboratory. The behavior in the vertical direction of particles 2 mm in diameter that have still-water terminal settling velocities ranging up to 4.0 cm/sec was observed. The particle velocity frequency distributions are approximately Gaussian, and their root-mean-square values prove to be nearly independent of terminal fall velocity. In the majority of cases, particle diffusivity is greater than fluid diffusivity. The average velocity of fall determined by experiment in the various turbulent fields is reduced by as much as 30% below the corresponding still-water terminal fall velocity. A simple theoretical model predicts the fall velocity reduction due to a nonlinearity in the drag force. The model is then extrapolated to describe the behavior of quartz sand under field-scale turbulence conditions. It predicts the time and distance required for such sand to reach terminal fall velocity in still water. (Knapp-USGS)
W70-05133

FORMATION OF DUNES AND ANTIDUNES IN OPEN CHANNELS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Taizo Hayashi.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7056, p 357-366, February 1970. 10p, 8 fig, 4 ref, append.

Descriptors: *Sediment transport, *Open channel flow, *Bed load, *Dunes, *Sand waves, Model studies, Mathematical models, Hydraulic models, Sedimentary structures, Scour, Channel morphology, Stream erosion.
Identifiers: Antidunes.

The formation of dunes and antidunes on the erodible bed of an open channel is studied analytically as a problem of stability of the erodible bed. The phase lag existing between the local sediment-transport rate and the local velocity on the bed plays an essential role in the formation of the sand waves. A physical model for the transport of sediment over a wavy bed is presented and a quantitative explanation of this phase lag is developed. The regions of occurrence of dunes, flat beds, and antidunes are examined in detail. Predicted regions of occurrence of those bed configurations are compared with experimental results previously summarized by Kennedy, the comparison showing a good agreement. (Knapp-USGS)
W70-05144

WAVE-INDUCED PRESSURES IN BEDS OF SAND,
Cambridge Univ. (England). Dept. of Engineering.
John F. A. Sleath.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7057, p 367-378, February 1970. 12 p, 5 fig, 1 tab, 5 ref, append.

Descriptors: *Water pressure, *Pore pressure, *Waves (Water), *Sands, Porous media, Permeability, Porosity, Anisotropy, Beaches, Hydraulics, Hydraulic models.
Identifiers: Pore pressure fluctuations.

Measurements of the variation of the fluctuating component of pressure have been made in two different beds of sand in a wave channel. The sand was laid from an overhead hopper, and it is shown that the stratification of the bed produced by this method causes the permeability to be different in the vertical and horizontal directions. It is suggested that a similar situation exists in the sea bed. Analytical relationships for the pressure and velocity distributions in such a situation are developed, and the agreement between theory and

experiment is found to be quite good. (Knapp-USGS)
W70-05145

DEPTH-INTEGRATING AND DIP SAMPLERS,
Agricultural Research Service, Riesel, Tex. Southern Plains Branch.
For primary bibliographic entry see Field 07B.
W70-05149

EFFECT OF FLUME WIDTH ON BED-FORM CHARACTERISTICS,
Hydraulics Research Station. Wallingford (England).
Maurice J. Crickmore.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7077, p 473-496, February 1970. 24 p, 9 fig, 4 tab, 22 ref, append.

Descriptors: *Bed load, *Sedimentary structures, *Channel morphology, *Width, Sand waves, Dunes, Scour, Stream erosion, Sediment transport, Hydraulics, Sands, Waves (Water), Flow resistance, Roughness (Hydraulic), Model studies, Flumes, Hydraulic models.
Identifiers: Bed-form shapes, flume studies.

The dimensions of bed-forms developed in laboratory channels are found to be a function of channel width. A 10% to 30% reduction is observed in the size of irregularities displayed by a self-formed bed of 0.6 mm diameter sand in a channel of 1.5 ft width, compared to that in a 5.0 ft wide channel, under closely similar water and sediment discharge conditions. Emphasis is placed on the need to standardize parameters for the dimensional description of bed-form profile, and the adoption of significant form height and the average distance between alternate zero-crossings is advised. The distribution of bed elevations conforms reasonably well with accepted theoretical distributions for water waves provided allowance is made for the greater spectral width values that characterize the bed-form profiles. Because sediment movement occurs as surface creep in this case, the transport, calculated from bed-form celerity and a form height parameter proposed by Mercer, is in close agreement with the measured total transport. (Knapp-USGS)
W70-05150

CLOGGING OF POROUS COLUMN OF SPHERES BY SEDIMENT,
California Univ., Berkeley. Coll. of Engineering.
Ramaswamy Sakthivadivel, and H. A. Einstein.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7075, pp 461-472, February 1970. 12 p, 6 fig, 5 ref, append. NSF Grant No GK-0591.

Descriptors: *Flow, *Porous media, *Deposition (Sediments), Sediment transport, Hydraulics, Sediment control, Filtration, Particle shape, Particle size, Porosity, Permeability, Interstices, Pores, Seepage, Voids.
Identifiers: Filter clogging.

When a sediment suspension moves downward at a constant laminar flow through a vertical porous column packed regularly with uniform spheres and having critical pores which permit passage of spheres smaller than 1/7-diam of the matrix grain, sediment deposition takes place by a characteristic mechanism known as 'bridging.' The critical parameter which controls the clogging of the matrix is the ratio of the pore size of the matrix to the sediment size. Sediment with diameters equal to or greater than half the critical pore diameter of the matrix will deposit and, in time, totally clog the matrix preventing further motion of sediment particles through the matrix. Sediment with diameters less than half the critical pore diameter will deposit only in the 'dead space' of the matrix by the straining mechanism. Considering sediment deposition in a vertical porous column as a stochastic process of pure birth, the time and space variation of sediment accumulation in the column is described by a second-order partial differential equation which has a closed solution. The hydraulic resistance of a clogging matrix is represented by an equation similar to Kozeny-Carman equation for head loss in flow through porous media and was verified experimentally. (Knapp-USGS)
W70-05151

PARTICLE SIZE OF RIVER SEDIMENTS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering; and Clyde River Purification Board, East Kilbride (Scotland).
George Fleming, and Thomas Poodle.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7068, p 431-439, February 1970. 9p, 10 fig, 9 ref.

Descriptors: *Sediment transport, *Discharge (Water), *Particle size, Sediment load, Sediments, Suspended load, Bed load, Rivers, Sedimentology.
Identifiers: River sediments, Scotland.

The relationships between particle size of river sediments and the variation in stream discharge were studied. The particle size of suspended and bed sediments remains relatively constant with variation in stream discharge. This condition was found from the analysis of results at four river sections on three rivers in Scotland and was also corroborated by results from research in the United States. The availability of material for transport by streams rather than purely hydraulic considerations may explain these findings. (Knapp-USGS)
W70-05153

ERODIBILITY OF CHANNELS WITH COHESIVE BOUNDARY,
State Univ. of New York, Buffalo. Dept. of Civil Engineering.
Emmanuel Partheniades, and Robert E. Paaswell.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7156, p 755-771, March 1970. 17 p, 5 fig, 28 ref, append.

Descriptors: *Sediment transport, *Scour, *Reviews, *Model studies, *Deposition (Sediments), Sedimentation, Hydraulics, Open channel flow, Sediment load, Stream erosion, Hydraulic models, Soil erosion, Canals, Open channels, Soil strength.
Identifiers: *Channel erodibility.

Results of laboratory investigations on the erodibility of cohesive soils by water were critically reviewed, summarized and compared with similar field results and with older empirical information. There is strong experimental evidence, substantiated by physical reasoning, that the bed shear stress strongly controls both the erosion and the deposition of cohesive sediments. The net attractive physicochemical interparticle forces in the soil provide the main resistance to erosion. For low values the soil shear strength itself does not have any measurable effect on soil erodibility, while for medium to high strength clays, the resistance to erosion seems in general to increase with the macroscopic strength. Under certain conditions erosion may stop completely after some scouring. The depth of this scouring and the final bed roughness increase with increasing shear stress and decreasing shear strength of the bed. A mechanistic model about the interaction between the surface of the bed and the flow is described which explains the observed phenomena. A set of tentative rules is suggested for design of stable channels with cohesive boundaries. (Knapp-USGS)
W70-05159

INITIAL INSTABILITY OF FINE BED SAND,
University Coll., London (England). Dept. of Civil Engineering.
Anthony J. Grass.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7139, p 619-632, March 1970. 14 p, 5 fig, 2 tab, 15 ref, append.

Descriptors: *Sediment transport, *Bed load, Open channel flow, Hydraulics, Turbulent flow, Turbulence, Shear stress, Sand waves, Dunes, Roughness (Hydraulic), Probability, Sands, Sediments, Sedimentology, Stochastic processes, Model studies, Hydraulic models.
Identifiers: Sand bed instability.

The initial entrainment characteristics of fine bed sand are defined in terms of the measured distributions of critical instantaneous bed shear stress associated with the observed movement of individual surface grains. Critical flow conditions are predicted by equating the lower extremes on the critical shear stress distributions to the upper extremes in the distribution of instantaneous bed shear stress. The method is applied to the case of two-dimensional channel flow over a flat bed and yields sufficiently consistent results to suggest an extension to Shields' curve for small grain Reynolds numbers. The detailed experimental observations illustrate the important role played by bed region turbulence. (Knapp-USGS)
W70-05161

THE MODERN SEDIMENTS OF PAMLICO SOUND, NORTH CAROLINA,
Delaware State Geological Survey, Newark; and North Carolina Univ., Chapel Hill. Dept. of Geology.
T. E. Pickett, and R. L. Ingram.
Southeastern Geology, Vol 11, No 2, p 53-83, 1969. 31 p, 13 fig, 1 tab, 25 ref.

Descriptors: *Sedimentation, *Sediments, *Bays, *North Carolina, Lagoons, Beaches, Bottom sediments, Sands, Provenance, Sediment transport, Sedimentology.
Identifiers: Pamlico Sound (NC), Lithology.

Pamlico Sound, North Carolina can be divided into 11 environments of deposition, each recognized by characteristic lithology: barrier island, central basin, cross lagoon shoal, finger shoal, inlet, lagoonal beach, lagoon near narrows, lagoon near river mouth, mainland marsh, marginal lagoon, protected mainland embayment. Water depth, sediment source, and wave and current action are the dominant factors controlling sediment distribution. (Knapp-USGS)
W70-05174

COMPARISON OF METHODS OF CALCULATING PARTICLE SIZE FROM HINDERED SETTLING RESULTS AND ITS APPLICATION TO INORGANIC OXYSALT PRECIPITATES,
Salford Univ. (England). Dept. of Chemistry; and Stand Grammar School, Whitefield (England).
D. Dollimore, and G. B. McBride.
Analyst, Vol 94, No 1122, p 760-767, September 1969. 8 p, 5 fig, 5 tab, 10 ref.

Descriptors: *Sedimentation, *Chemical precipitation, *Particle size, *Settling velocity, Suspension, Aqueous solutions, Water chemistry, Chemical reactions, Calcium carbonate, Flocculation.
Identifiers: Particle size analysis.

The methods of calculating particle size from the results of hindered settling determinations are critically compared and a simple and rapid method of determining particle size is given. In the precipitation of basic copper carbonate the results of hindered settling measurements are compared with those from the use of a Coulter counter and from wet sieving. An analysis was made of the conditions affecting calcium carbonate particle size in precipitation processes and the mechanism of precipitation from saturated solutions. Information was obtained about the amount of immobile liquid carried down by the precipitate as it settles. The mechanism of flocculation is explained on the basis of hydrogen bonding between the flocculating agent and hydroxyl groups on the surface. A comparison of the particle size and the settled volume after precipitation can, for particular samples, be correlated. When a direct relationship occurs this

enables information to be obtained about the attractive forces between the particles and the variation of this force with the precipitation conditions. (Knapp-USGS)
W70-05179

ON THE EFFECTS OF SUSPENDED SEDIMENTS TO THE BED ROUGHNESS,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
Hideo Kikkawa, Hiroyoshi Shi-igai, and Shoji Fukuoka.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A7, p 49-56, 1967. 8 p, 6 fig, 9 ref.

Descriptors: *Roughness (Hydraulic), *Suspended load, *Turbulent flow, *Open channel flow, Sediment transport, Model studies, Mathematical models, Hydraulic models, Bed load.
Identifiers: Suspended load-hydraulic roughness relations.

To express the roughness of the flow precisely and systematically for the various bed configurations in open channels with movable beds, the logarithmic velocity formula is used for mean velocity. If the effect on roughness caused by suspended sediment concentration is removed by Karman's constant variation, the relative (equivalent) roughness may be expressed definitely by the hydraulic characteristics. (Knapp-USGS)
W70-05188

MOVABLE BED MODEL FOR ALLUVIAL CHANNEL STUDIES,
Corps of Engineers, Omaha, Nebr.
Alfred S. Harrison, and Warren J. Mellema.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A25, p 202-209, 1967. 8 p, 6 fig, 5 ref.

Descriptors: *Model studies, *Missouri River, *Hydraulic models, Sediment transport, Navigation, Alluvial channels, Hydraulic similitude, Discharge (Water), Bed load, Sedimentation, Channel morphology.
Identifiers: Missouri River models, Corps of Engineers (US Army).

A movable bed model facility was developed for studying problems in the design and maintenance of the channel stabilization and navigation project on the Missouri River. The bed material is ground walnut shells (Specific Gravity 1.30) which is very similar to Missouri River sand in gradation, settling characteristics, and nature of bar and bank formations. Although similarity criteria have been developed for modeling alluvial channels, practical limitations force many distortions in similitude criteria. This makes the selection of scales for modeling stabilized river reaches a semiempirical process in which depth and discharge scales are adjusted until the model appears to reproduce the most important over-all channel characteristics in the prototype. Several practical constraints on the choice of scales are discussed. The selection of scales for modeling navigation channel problems in two Missouri River reaches is described. Techniques have been developed for measuring geometrical, hydraulic, and sedimentation characteristics in the model with reasonable precision. This permits studies of hydraulic resistance and sedimentation characteristics in alluvial channels and avoids the nonsimilarity to natural rivers imposed by the straight side walls in laboratory channels. Hydraulic resistance in the model is shown to fit the same relationship as natural river reaches on the Missouri and Mississippi Rivers. (Knapp-USGS)
W70-05192

BOTTOM SHEAR MEASUREMENT IN AN OPEN CHANNEL FLOW,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
T. Sitki Bursali.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A24, p 194-201, 1967. 8 p, 11 fig, 2 tab.

Descriptors: *Open channel flow, *Alluvial channels, *Channel morphology, Sand waves, Roughness (Hydraulic), Shear drag, Turbulent flow, Model studies, Hydraulic models, Shear stress.
Identifiers: Turkey.

Resistance to flow, as well as the bed load movement in an alluvial channel can be defined starting from the notion of shear velocity. Formulas are not valid in an alluvial channel if the bottom is covered with sand waves, dunes or antidunes. Theoretical computation of shear stress on a dune is nearly impossible because of the secondary currents and perturbations in the vicinity of the bottom. Whereas, a direct measurement apparatus would be able to inform us about the skin friction on any point of the dune as well as the total force exerted by the flow. For this purpose, a direct shear measurement apparatus has been realized. Preliminary experiments on smooth and rough bottoms have given satisfactory results. They are compared with the computed results and surface pitot tube measurements. (Knapp-USGS)
W70-05193

EXPERIMENTAL STUDY OF FLUME-BED ROUGHNESS,
Research Inst. for Water Resources Development, Budapest (Hungary).
Laszlo Rakoczi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A22, p 181-186, 1967. 6 p, 1 fig, 3 tab, 4 ref.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Bed load, Sands, Gravels, Streamflow, Sediment transport, Discharge (Water), Sediment discharge, Sand waves, Model studies, Hydraulic models, Laboratory tests.
Identifiers: Hungary.

Laboratory experiments were carried out using four different sand and sand-gravel mixtures as bed material to determine the share of the total energy of flow required for sediment transport. The dune bed obtained by the first run was artificially fixed, then the original discharge was let again into the flume and the differences in the hydraulic parameters resulting from fixing of the dunes were determined. Thus, the total head loss of flow could be separated into three parts due to bed forms, grain size roughness, and transport of sediment. The results show the primary importance of the slopes, in comparison to depths or hydraulic radii in determining the sediment-transporting capacity. (Knapp-USGS)
W70-05194

THE EFFECT OF SAND RIPPLES ON THE INCREASE OF RIVER BED ROUGHNESS,
Hydraulic Research Inst., Prague (Czechoslovakia). Dept. of Hydraulics and Hydrology.
Jaroslav Martinec.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A21, p 172-180, 1967. 9 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Channel morphology, *Roughness (Hydraulic), *Alluvial channels, *Sand waves, Ripple marks, Turbulent flow, Bed load, Sediment transport, Mannings equation, Rivers.
Identifiers: Czechoslovakia, Loznice River.

As a contribution to the problem of sand ripples and their effect on the resistance to flow in alluvial channels, experimental data are presented which were obtained by repeated comparative measurements in a representative river reach. The increase of flow resistance was expressed as a function of the average height of roughness. A velocity formula containing the factor of relative roughness was used to calculate this function. The height of ripples increased with the growing discharge and caused a gradual increase of flow resistance expressed as the effective height of roughness. A deterioration of flow conditions was observed for higher discharges due to sediment transport or different shapes of ripples. The measured variation of the Manning coefficient n from 0.0165 to 0.034 indicates the importance of this problem. (Knapp-USGS)
W70-05195

OBSERVED FORMS OF BED ROUGHNESS IN AN UNSTABLE GRAVEL RIVER,
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 02E.
W70-05196

DETERMINATION OF ROUGHNESS COEFFICIENTS FOR VERY IRREGULAR RIVERS WITH LARGE FLOODPLAINS,
Institute for Water Resources, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 02E.
W70-05197

COLUMBIA RIVER BED FORMS,
Washington Univ., Seattle. Dept. of Geology; and Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02E.
W70-05198

RECOGNITION OF SCOUR OF RIVER CHANNEL FOR DESIGN PURPOSES,
Corps of Engineers, Kansas City, Mo.
For primary bibliographic entry see Field 08B.
W70-05199

EFFECT OF BEDLOAD MOVEMENT ON THE ROUGHNESS COEFFICIENT VALUE,
Hydraulic Research Inst., Bratislava (Czechoslovakia).
Jan Vincent.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A20, p 162-171, 1967. 10 p, 7 fig, 2 tab, 5 ref.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Sand waves, Turbulent flow, Channel morphology, Bed load, Sediment transport, Model studies, Hydraulic models.
Identifiers: Czechoslovakia.

The effect of bedload movement on the magnitude of the roughness coefficient is investigated on the basis of experimental results in a rectangular flume, 70 m long. Because of the effect of bedload movement in dunes the values of roughness coefficient substantially increased. On the basis of results obtained during the experimental research it was possible to derive empirical equations for the computation of roughness coefficient and bedload movement in the range investigated. The conditions for the initiation of spiral water movement and transverse discharge in a direct rectangular flume are presented in relation to hydraulic parameters. (Knapp-USGS)
W70-05200

ABOUT THE ROUGHNESS IN ALLUVIAL CHANNELS WITH COMPARATIVELY COARSE BED MATERIALS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
L. Veiga da Cunha.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A10, p 76-84, 1967. 9 p, 4 fig, 7 ref.

Descriptors: *Roughness (Hydraulic), *Sediment transport, *Alluvial channels, *Rivers, Turbulent flow, Particle size, Bed load, Equations, Regime, Open channel flow, Flood plains, River training.
Identifiers: *Portugal, Mondego River.

The Mondego River flows through the central area of Portugal, having its origin in Serra da Estrela and its mouth in the Atlantic Ocean, near Figueira da Foz. Its catchment area is about 6700 sq km and its total length is 240 km. In its upper reach, about 200 km in length, the river has the characteristics of a mountain stream, flowing in a deep valley. In its last 40 km the river flows in a plain, tending to form meanders and to divide into several stretches with rather unstable characteristics. In this zone, the competence of the river is small and decreases toward the mouth, so that the river bed is raised by deposits of material carried from upstream. The river channel appears to obey Meyer-Petter and Muller's Law but the change of the river bed roughness in function of the mean velocity is different from the change usually observed. When the friction factor corresponding to the bed features was plotted as a function of a flow parameter, the experimental points obey a law different from the one currently used for predicting discharge curves. (Knapp-USGS)
W70-05201

THE ANALYSIS AND ESTIMATES OF ENERGY LOSSES BY INSTANTANEOUS VELOCITY DISTRIBUTION OF STREAMS WITH MOVABLE BED,
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02E.
W70-05204

INDUCTIVE APPROACH TO PHASES OF MOBILE-BED ROUGHNESS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-05205

HYDRAULIC RESISTANCE OF A MOVABLE CHANNEL BED AND SEDIMENT GRADING INFLUENCE,
Akademiya Nauk Armyanskoi SSR, Erevan.
I. V. Egiazaroff.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A 9, p 68-75, 1967. 8 p, 5 fig, 16 ref.

Descriptors: *Roughness (Hydraulic), *Particle size, *Sediment transport, *Bed load, Alluvial channels, Roughness coefficient, Equations, Turbulent flow, Transition flow, Regime, Open channel flow.
Identifiers: Sediment size analysis.

A theoretical approach to bed load transport and channel resistance is presented, covering both uniformly graded and poorly sorted sediments. An empirical discharge-sediment size analysis is discussed and a grading curve is proposed to aid in granulometric studies. (Knapp-USGS)
W70-05206

LOCAL SCOUR IN BEDS OF SAND AND GRAVEL DOWNSTREAM FROM A SOLID APRON,
Sydney Univ. (Australia).
R. D. Watkins.
Inst Eng, Aust. Civ Eng Trans, Vol CEII, No 1, p 97-106, Apr 1969.

Descriptors: *Scour, Erosion, *Stream erosion, *Streambeds, Hydraulic models, Sands, Gravels, *Aprons, Potholes, Degradation, Depth, *River beds, Model tests, Prototypes, Hydraulics, Experimental data.
Identifiers: *Erodible-bed channels, *Bed profiles, Similitude, Scale effect, Rectangular channels, Bed movements.

A basic requirement for model data to be scaled into corresponding values in its prototype is knowledge of the similarity of the processes in both systems. An investigation was aimed at gaining knowledge of the performance of systems where scouring occurred in an erodible bed of noncohesive solid particles downstream from a hydraulic structure; the particular case studied was an erodible bed downstream from a solid horizontal apron in a rectangular channel. Observations were made of scour profile development in sand and in several gravels having particle sizes ranging between 1/50 in. and 3/4 in.; tests were made of each material being subjected to various waterflows having stream velocities up to 7 ft/sec. The main findings were: (1) scour development progressed from sheet scouring to pothole scouring; (2) a general similarity of pothole scour profiles occurred in all materials, although there were slight but noticeable differences; and (3) a new value for change of the maximum scour depth as a function of time is given. (USBR)
W70-05237

EROSION AT THE BASE OF FLIP BUCKETS,
Winsor Univ. (Ontario).
S. P. Chee, and P. V. Padiyar.
Eng J, Can, Vol 52, No 11, p 22-24, Nov 1969. 3 p, 3 fig, 1 tab, 14 ref.

Descriptors: Erosion, *Flip buckets, Energy dissipation, Scour, Depth, Hydraulic models, *Stream erosion, Geometric shapes, Model tests, Time, Hydraulics, Prototypes, *Spillways, *Stilling basins.
Identifiers: *Plunge basins, Bed profiles, Holes, Energy dissipators.

As a result of the performance of several recently constructed flip bucket spillways in which severe scour occurred at the bases threatening the structures, a new design philosophy is being studied. Causes of the unforeseen scour are: (1) irregularly shaped scour holes that form because of the heterogeneous composition of riverbeds, and (2) the erosive action of secondary currents generated in the irregularly shaped holes. The destructive secondary currents can be eliminated by excavating in advance a plunge pool corresponding to the configuration and dimensions of the scour hole obtained in model tests using a granular bed. The shapes of scour holes formed in a bed of homogeneous granular material using flip bucket models having 30 deg exit angles are reviewed. Plunge basin dimensions can be derived from the equations resulting from the study. (USBR)
W70-05245

FACTORS AFFECTING GROWTH OF ROOTED AQUATIC PLANTS IN A RESERVOIR,
Tennessee Valley Authority, Muscle Shoals, Ala. Environmental Biology Branch; and Washington Univ., Seattle. Dept. of Civil Engineering.
W. H. Peltier, and E. B. Welch.
Weed Science, Vol 18, No 1, p 7-9, 1970. 3 fig, 7 ref.

Descriptors: *Reservoirs, *Aquatic plants, Light, Water level fluctuations, Suspension, Turbidity, Rainfall, Sedimentary productivity, Sedimentation, Mosquitoes, Reservoir silting.
Identifiers: Pickwick Reservoir (Ala), Najas, Napas minor, Potamogeton pectinatus, Elodea canadensis, Light intensity, Langley/day units.

Nitrogen and phosphorus contents of Pickwick Reservoir, Alabama, were determined during the period 1965-1969. The results showed no correlation with year-to-year growth of rooted aquatics, Najas guadalupensis and Najas minor. Rank growth of the plants during 1962 and 1965 is attributed to limited rainfall and greater availability of light during these years. Extreme fluctuation of the reservoir level and reduced light penetration of turbid water are contributing factors. (Wilde-Wisconsin)
W70-05260

GRANULOMETER--A SEDIMENT ANALYZER DIRECTLY WRITING GRAIN SIZE DISTRIBUTION CURVES,
Central Geological Inst., Prague (Czechoslovakia).
For primary bibliographic entry see Field 07B.
W70-05268

A HYDRAULIC CORER FOR USE IN WATER SATURATED SEDIMENT,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 07B.
W70-05398

PRELIMINARY EVALUATION OF A CORE SCINTILLATION COUNTER FOR BULK DENSITY MEASUREMENT IN MARINE SEDIMENT CORES,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
For primary bibliographic entry see Field 07B.
W70-05401

PIGMENTS FROM THE BOTTOM DEPOSITS OF AN ENGLISH LAKE,
University Coll., London (England). Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-05402

THE DEVELOPMENT OF DISCONTINUOUS GULLIES IN A PUMICE CATCHMENT,
Sydney Univ. (Australia). Dept. of Geography.
For primary bibliographic entry see Field 04D.
W70-05471

SUBSTITUTION OF SPACE FOR TIME IN A STUDY OF SLOPE DEVELOPMENT,
University of Western Ontario, London. Dept. of Geography.
D. M. Welch.
Journal of Geology, Vol 78, No 2, p 234-239, March 1970. 6 p, 7 fig, 15 ref.

Descriptors: *Geomorphology, *Erosion, *Slopes, Weathering, Topography, Terrain analysis, Geologic control, Land forming, Mountains.
Identifiers: *Slope development, Moraines.

Existing theories of slope development are questioned in that changes over time are not supported by direct evidence. Field data are presented which relate changes in the slope characteristics of recessional moraines to a time scale controlled by actual dates. Recently exposed moraines have irregular surfaces and show a wide range of slope angles. Frost-heaving and surface runoff create smooth slopes of 25-30 deg inclination. These changes take place uniformly with respect to time. No significant changes take place after 35 years. (Knapp-USGS)
W70-05473

TIDAL INLETS AND WASHOVER FANS,
Smithsonian Institution, Washington, D.C. Div. of Sedimentology.
For primary bibliographic entry see Field 02L.
W70-05474

CLAY MINERAL COMPOSITION OF LATE PLEISTOCENE AND HOLOCENE SEDIMENTS OF CASCADIA BASIN, NORTHEASTERN PACIFIC OCEAN,
Oregon State Univ., Corvallis. Dept. of Oceanography.
John R. Duncan, L. D. Kulm, and G. B. Griggs.
Financial support provided by grants from Nat Sci Found, and contract with Office of Naval Research. Journal of Geology, Vol 78, No 2, p 213-221, March 1970. 9 p, 6 fig, 20 ref. NSF Grants GP-5076 and GA-1246 and ONR Contract Nonr-1286 (10).

Descriptors: *Clay minerals, *Bottom sediments, *Pacific Ocean, Clays, Geology, Provenance, Columbia River, Mineralogy, Diagenesis, Glaciation, Weathering, Columbia River Basin.
Identifiers: Cascadia Basin.

Systematic lateral and vertical trends are detectable in proportions of montmorillonite, illite, and chlorite occurring in the lutites of late Pleistocene and Holocene sediments from southern Cascadia Basin and Blanco Fracture Zone. In the Holocene sediments, a lateral pattern radiates outward from the mouth of the Columbia River into the marine environment; the percentage of chlorite and, to a lesser extent, illite, increases with distance from the source. The percentage of montmorillonite presently introduced by the Columbia River to the Pacific Ocean is apparently higher than that of adjacent continental sources. In the late Pleistocene marine sediments, proportionally more illite is present than in the overlying Holocene sediments. Because the change in clay mineral composition is abrupt, and associated with the Pleistocene-Holocene faunal boundary, it is not believed to be the result of gradual marine diagenetic processes. Instead, it probably results from a glacially controlled change in the rate at which clays of varying composition are contributed by the different subbasins of the Columbia River to southern Cascadia Basin. (Knapp-USGS)
W70-05475

SUBMARINE CANYON ORIGIN ON UPPER CONTINENTAL SLOPE OFF CAPE HATTERAS,
Atlantic Oceanographic and Meteorological Labs., Miami, Fla.
For primary bibliographic entry see Field 02L.
W70-05476

QUANTITATIVE ANALYSIS OF BEACH SAND MOVEMENT, VIRGINIA BEACH, VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
John D. Boon, III.
Sedimentology, Vol 13, No 1-2, pp 85-103, October 1969. 19 p, 10 fig, 2 tab, 20 ref.

Descriptors: *Sediment transport, *Beaches, *Tracers, *Tracking techniques, Sands, Surf, Waves (Water), Currents (Water), Beach erosion, Sampling, Dunes, Dye releases, Statistics, Stochastic processes, Statistical models, Ocean waves, Littoral drift.
Identifiers: Virginia Beach (Va).

A simplified stochastic-process model involving statistical procedures is used to analyze sand tracer displacement data on an ocean beach. The procedures provide meaningful estimates of the direction and magnitude of the movement of beach sand through set intervals of time. Results of a single tracer experiment are reported for a beach located near Virginia Beach, Va. Using a rectangular sampling grid, tracers were recovered at fixed times, then considered as items in a sample of X and Y displacements from the point of release. Comparison of the adjusted means of these samples on a time-stratified basis gave estimates of average particle velocity in two dynamic zones: (1) swash zone: v (X) = 0.44 ft/min longshore; (2) surf zone: v (Y) = 0.37 ft/min offshore. Using an estimate of the thickness of the mobile layer (the depth interval in which semi-continuous motion of beach sand occurs), a further estimate of the rate of longshore sand transport was computed at 440 cu yards/day. (Knapp-USGS)
W70-05520

THE BED FORM ON RECTILINEAR AND CURVILINEAR RIVER AND BIG CHANNEL SECTIONS,
For primary bibliographic entry see Field 02E.
W70-05525

HYDRAULIC SOLUTION AND DEFINITION OF THE UNSTABILITY CRITERION OF STREAM WANDERING WITHIN BED, AND VORTEX ZONES,
Kharkov Vodokanalniiproekt Inst. (USSR). Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02E.
W70-05533

EFFECTS OF STAGES ON SCOUR ALONG RIVERBANKS,
US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Hydraulics Div.
For primary bibliographic entry see Field 02E.
W70-05534

COMPACTNESS VARIABILITY OF ESTUARINE SEDIMENTS: AN IN SITU STUDY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 02L.
W70-05541

2K. Chemical Processes

GEOCHEMICAL ENVIRONMENTS AND CARDIOVASCULAR MORTALITY RATES IN GEORGIA,
Geological Survey, Washington, D.C.
Hansford T. Shacklette, Herbert I. Sauer, and A. T. Miesch.
Available from Superintendent of Documents, U.S. Government Printing Office, Wash, DC 20402 - Price 50 cents. Geological Survey Professional Paper 574-C, pp C1-C39, 1970. 39 p, 7 fig, 13 tab, 25 ref.

Descriptors: *Water chemistry, *Water quality, *Public health, *Georgia, Trace elements, Weathering, Leaching, Diseases, Human pathology, Hardness (Water).
Identifiers: *Cardiovascular disease rates.

Nine contiguous counties of northern Georgia that have a low cardiovascular mortality rate lie in an area where the rocks, by weathering, continuously contribute a supply of minor elements to the soil. Nine counties of central and southcentral Georgia, in contrast, have a high cardiovascular mortality rate, and the soil is largely composed of materials that generally are deficient in weatherable minerals. The concentrations of the elements that were studied in soils from the two areas tend to be significantly different and are generally higher in the low-death-rate area. The difference in element composition of soils from the two areas is not apparent in analyses of most vegetables. The concentrations of most elements in tree samples tend to be higher in the low-rate area; therefore, trees appear to be more sensitive than vegetables to the variation in element content of soils. If geochemical differences between the two areas do, in fact, have a causal relationship to death from cardiovascular diseases, the cause would appear to be a dietary deficiency, rather than an excess, of the elements that were studied. (Knapp-USGS)
W70-05067

THE USE OF AMALGAM ELECTRODES TO MEASURE ACTIVITY COEFFICIENTS OF METAL SALTS IN MULTICOMPONENT SALT SOLUTIONS,
Tyco Labs., Inc., Waltham, Mass.
For primary bibliographic entry see Field 03A.
W70-05077

SOLUBILITIES OF SOME SILICATE MINERALS IN SALINE WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
A. Gene Collins.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price 45 cents. Office Saline Water Research and Development Progress Report No 472, August 1969. 27 p, 18 fig, 10 tab, 4 ref. OSW Contract No 14-01-0001-1146.

Descriptors: *Water chemistry, *Silicates, *Clay minerals, *Solubility, Calcium chloride, Sodium chloride, Saline water, Temperature, Pressure, Illite, Kaolinite, Montmorillonite, Saline water systems.
Identifiers: *Serpentine, *Nontronite, Sodium bicarbonate, Magnesium chloride, Silicon.

In the systems water, water-calcium chloride, water-magnesium chloride, water-sodium chloride, and water-sodium bicarbonate, the solubilities of illite, kaolinite, montmorillonite, nontronite, and a serpentine were determined as a function of time at ambient temperatures and pressures. Water-calcium chloride and water-sodium chloride systems from 30 deg to 200 deg C and from 2,500 to 15,000 psi were also investigated. In general, the solubilities of silicon from clay minerals decreased with increasing concentrations of dissolved salts at ambient temperatures and pressures. Empirical equations were derived from the smoothed curves plotted from silicon molality versus time. (Carstea-USGS)
W70-05078

INTEGRATION OF ENERGY CONVERSION AND BIOSYNTHESIS IN THE PHOTOSYNTHETIC BACTERIUM RHODOPSEUDOMONAS CAPSULATA,
Indiana Univ., Indianapolis. Dept. of Microbiology.
Gary A. Sojka, and Howard Gest.
Proceedings of the National Academy of Sciences, Vol 61, No 4, p 1486-1493, 1968. 2 fig, 3 tab, 22 ref.

Descriptors: *Light, *Light intensity, *Bacteria, *Energy conversion, Synthesis, Growth rates, Proteins.
Identifiers: *Intermittent illumination, Light cycles, Rhodopseudomonas capsulata, Protein:RNA ratio, ADP, AMP, Bacteriochlorophyll, Adenoisine triphosphate, Adenylate nucleotides.

The growth rate of bacterium Rhodopseudomonas capsulata was inhibited in intermittent light, even with cycles as short as 10 seconds. With a 60-minute cycle, the growth rate attained its maxiumum and was virtually zero in dark intervals. Cells grown in continuous saturating light showed the lowest protein: ribonucleic acid (RNA) ratio. Intermittency in 1-minute cycle lead to a protein decrease and a greater decrease in the RNA level. The values obtained with 1- and 2.4-minute cycles suggested that growth is a function of both ribosome content and the 'average' chemical energy flux. The 1-minute cycle has greatly increased bacteriochlorophyll (BChl) content of cells, indicating a correlation between the growth rate and BChl synthesis. The study suggested that intermittent illumination is pulsing of adenosine triphosphate (ATP) formation. Its congeners, adenosine di- and monophosphates (ADP and AMP) may regulate the biosynthesis of key macromolecular cell constitutents. In turn, the ATP generation rate and stable microconcentrations of adenylate nucleotides may control synthesis of macromolecular cell components. (Wilde-Wisconsin)
W70-05086

NITRATES IN THE ENVIRONMENT,
Wisconsin Univ., Madison. Dept. of Civil Engineering.

M. Starr Nichols.
Journal American Water Works Association, Vol 57, No 10, p 1319-1327, 1965. 25 ref.

Descriptors: *Nitrogen, *Atmosphere, *Biosphere, Fertilization, Nitrogen fixation, Denitrification, Wastes, Nitrogen fixing bacteria, Ammonia, Odor, Aquatic plants, Groundwater, Toxicity, Waste treatment.
Identifiers: Nitrogen deposits, Mineralization, Methemoglobinemia, Livestock poisoning, Silage gas, Odor prevention.

Atmospheric nitrogen, supplying 1600 pounds of elemental nitrogen per square foot of the world, is the most important source of nitrogen fertilizer. Nonsymbiotic and symbiotic nitrogen-fixing organisms fix nitrogen in the biosphere from atmospheric supplies. These organisms include 10 species of bacteria and 6 strains of blue-green algae. Denitrifying organisms cycle nitrogen back to the atmosphere. Nitrifying organisms, such as Nitrobacter, oxidize organic nitrogenous compounds in waste matter to nitrate after ammonification occurs. Mineralization of nitrogen in waste matter is responsible for most nitrogen mineral deposits found in the world. Slightly alkaline buffered environment and aerobic conditions will produce nitrates at enormous rates to supply nutrient needs. Aquatic growths in lakes from overfertilization may be nature's method of conserving nitrogen fertilizer. Presence of nitrogen compounds can indicate pollution. Nitrate concentration above 45 ppm might cause methemoglobinemia. Livestock is susceptible to nitrate poisoning. Sodium nitrate added to waste treatment lagoons limits odors and enhances biochemical oxygen demand reduction. Nitrates are added to natural water by leaching and runoff from wastes and poorly managed fertilizing practices. (Bannerman-Wisconsin)
W70-05099

EFFECT OF TOTAL ILLUMINATION UPON CONTINUOUS CHLORELLA PRODUCTION IN A HIGH INTENSITY LIGHT SYSTEM,
Army Natick Labs., Mass. Food Lab.
Robert O. Matthern, John A. Kostick, and Isao Okada.
Biotechnology and Bioengineering, Vol 11, No 5, p 863-874, 1969. 3 fig, 4 tab, 6 ref.

Descriptors: *Algae, *Light intensity, *Chlorella, *Productivity, Aerobic conditions, Fermentation, Photosynthesis, Temperature, Foods, Energy conversion, Light quality, Gases, Heat transfer, Nutrients, Hydrogen ion concentration, Infrared radiation, Chlorophyll, Time, Oxygen, Depth.
Identifiers: *Total illumination, *Continuous illumination, *Systems, Packed cell volume, Dry weight concentration, Light-dark phasing, Exchange, Concentrations, Cell count, HILIS.

Mass photosynthetic algal culture has been beset with two major problems preventing the ultimately economical and practical production of algae as food: large culture volume requirements and poor energy conversion efficiencies. A high intensity light system (HILIS) was designed and constructed to define the environmental parameters affecting algae production. HILIS incorporates the basic concepts of an aerobic fermenter for heterotrophic cells with high intensity illumination for photosynthetic studies. Of nine parameters considered, temperature and light intensity studies, using Chlorella 71105, have been completed. Total illumination was varied from 25,000 to 300,000 lumens (30 times intensity of sunlight as measured at earth's surface) in 7.7 liter culture. Effect of illumination upon growth was measured as cell concentration and total daily algal production when operating the HILIS as a continuous system at a dilution rate of 0.91/day. Growth may be expressed as a log function of illumination. A maximum algal concentration of 25.5 grams/liter, dry weight basis, was attained at 300,000 lumens. Algal production is a function of many environmental growth conditions, not merely illuminated surface area and depth of culture relative to light source. (Jones-Wisconsin)
W70-05106

THE EFFECTS OF IRON AND THORIUM IONS ON THE KINETICS OF PRECIPITATION OF BARIUM SULFATE,
Kansas Water Resources Research Inst., Manhattan.
Clark E. Bricker, and David J. Myers.
Available from the Clearinghouse as PB-190 570, $3.00 in paper copy, $0.65 in microfiche. Kansas State University Water Resources Research Institute Project Completion Report, Contribution No 34, 1969. 27 p, 11 fig, 3 tab, 18 ref, append. OWRR Proj No A-020-KAN.

Descriptors: *Water chemistry, *Chemical precipitation, *Catalysts, *Sulfates, Iron compounds, Magnesium compounds, Ions, Kinetics.
Identifiers: Barium sulfates, Thorium, Hydroxides, Chemical reaction kinetics.

The Coulter Counter has been used to record in situ growth and aging curves for the precipitation of barium sulfate. Teflon was found to catalyze the nucleation of barium sulfate, and iron and thorium were found to alter the mechanism of precipitation by changing the rates of nucleation and growth. A simple equation is derived from the Volmer-Becker-Doring theory, which relates the number of ions in the critical nucleus to the critical supersaturation ratio. This is used to examine the effect of thorium on homogeneous nucleation. Small concentrations of thorium were found to raise the critical supersaturation ratio and affect the growth rate. Similar effects were found when ferric ions were added, but magnesium ions were found to affect neither the nucleation nor the growth rates. It is postulated that the effects which were observed are due to hydroxy complexes which are formed by hydrolysis of the polyvalent cations. (Knapp-USGS)
W70-05122

ON THE RELATION BETWEEN DROP SIZE AND CONCENTRATION OF TRACE ELEMENTS IN RAINWATER,
Frankfurt Univ. (West Germany). Institut fuer Meteorologie und Geophysik.
Hans-Walter Georgii, and Dieter Wotzel.
Journal of Geophysical Research, Vol 75, No 9, p 1727-1731, March 20, 1970. 5 p, 4 fig, 7 ref.

Descriptors: *Water chemistry, *Trace elements, *Raindrops, Rainfall, Rain water, Water analysis, Solutes, Particle size, Evaporation.
Identifiers: Rain water chemistry.

Rainfall was separated according to drop-size spectrum with a drop-size discriminator. Chemical analysis of the different size fractions shows that small drops contain a higher concentration of impurities than large drops from the same rainfall. This result is valid for all components analyzed. The results can be explained on the basis of washout of trace substances and partial drop evaporation below the cloud base. (Knapp-USGS)
W70-05132

COMPOSITION OF DISSOLVED GASES IN THE GROUND WATERS OF CENTRAL KUZBASS,
P. I. Zelenovskiy.
Transl from Geokhimiya, No 4, p 501-505, 1969. Geochemistry International, Vol 6, No 2, p 384-387, January 1970. 4 p, 2 fig, 3 ref.

Descriptors: *Geochemistry, *Groundwater, *Coals, Gases, Methane, Carbon dioxide, Mineral water, Groundwater movement.
Identifiers: USSR, Kuzbass, Metamorphism.

The variation of nitrogen, methane, and carbon dioxide with depth in drill cores from anticlines and synclines in Central Kuzbass is presented graphically. A carbon dioxide, or carbon dioxide-nitrogen zone underlies a methane zone and is underlain by a second methane zone. This effect is discussed in relation to metamorphism of coal beds. (Knapp-USGS)
W70-05135

BORON IN GROUNDWATERS OF THE CRETACEOUS OF THE WEST CAUCASUS FORELAND,
Voronezh State Univ. (USSR).
A. Ya. Smirnova.
Transl from Geokhimiya, No 3, p 349-356, 1969. Geochemistry International, Vol 6, No 2, p 301-307, January 1970, 7 p, 1 fig, 2 tab, 12 ref.

Descriptors: *Geochemistry, *Water chemistry, *Brackish water, *Trace elements, Groundwater movement, Solubility, Aqueous solutions, Geologic control, Faults (Geology), Geology, Hydrogeology, Leaching.
Identifiers: USSR, West Caucasus Foreland, Boron.

The distribution of B in waters of Cretaceous deposits of the Western Caucasus is closely related to the degree of mineralization and the chemical composition of the waters. The B content increases for increasing salt content in the range 0.5 - 25 g/liter, but decreases in brines and highly saline waters. The most favorable waters for the accumulation of B are brackish and weakly saline waters of the sodium bicarbonate type. The amount of B is also related to the tectonic structure of the area: B waters are usually associated with deep faults and mud volcanoes. (Knapp-USGS)
W70-05137

HYDROGEOCHEMISTRY OF GOLD,
A. M. Chernyayev, L. E. Chernyayeva, M. N. Yeremeyeva, and M. I. Andreyev.
Transl from Geokhimiya, No 4, p 449-459, 1969. Geochemistry International, Vol 6, No 2, p 348-358, January 1970. 11 p, 4 fig, 5 tab, 36 ref.

Descriptors: *Geochemistry, *Groundwater, *Surface waters, *Gold, Trace elements, Leaching, Hydrogeology, Water chemistry, Igneous rocks, Clays, Sandstones, Carbonate rocks, Ions, Colloids, Suspension.
Identifiers: USSR, Gold hydrogeochemistry.

A literature review and original analyses of natural waters of North Kazakhstan were used in a study of the Au content of natural waters and the chemical form of Au during migration. Analyses range from less than 0.1 to 4 ppb Au and show that the Au content does not depend on the chemical composition of the waters. Groundwaters circulating above Au-bearing ore bodies have high concentrations of Au, As, Ag, and Bi. Au can migrate in the form of ions, colloids, mechanical suspensions, and other forms depending on the particular physiocochemical conditions. (Knapp-USGS)
W70-05138

EVALUATION OF WATER-QUALITY MONITORING IN THE ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07A.
W70-05170

MINE DRAINAGE IN THE NORTH BRANCH POTOMAC RIVER BASIN,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
For primary bibliographic entry see Field 05C.
W70-05176

COMPARISON OF METHODS OF CALCULATING PARTICLE SIZE FROM HINDERED SETTLING RESULTS AND ITS APPLICATION TO INORGANIC OXYSALT PRECIPITATES,
Salford Univ. (England). Dept. of Chemistry; and Stand Grammar School, Whitefield (England).
For primary bibliographic entry see Field 02J.
W70-05179

DATA FOR SPRINGS IN THE NORTHERN COAST RANGES AND KLAMATH MOUNTAINS OF CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02F.
W70-05182

A CHEMICAL ENGINEER'S GUIDE TO SEA-WATER,
Dow Chemical Co., Freeport, Tex.
W. F. McIlhenny, and M. A. Zeitoun.
Chem Eng, Vol 76, No 24, 25, p 81-86, 251-256, Nov 3, 17, 1969. 12 p, 6 fig, 8 tab, 13 ref.

Descriptors: *Sea water, Chemical engineering, Oceans, *Saline water, Saline water systems, Salinity, Physical properties, *Water chemistry, Chemical properties, Marine animals, Marine borers, Marine engineering, Fouling, Corrosion, Waste disposal, Chlorination, Chemical analysis, Chemical precipitation, Foaming, Demineralization, Water utilization.
Identifiers: Salt recovery, Salt solutions.

In exploiting the ocean's resources, from mineral recovery to eventual construction of plants on the sea floor, chemical engineers must become familiar with the properties and behavior of sea water. Sea water is more than a solution of mineral ions; it also contains dissolved gases, complex molecular aggregations, a wide variety of organic compounds, colloidal and larger suspended matter, insoluble organic compounds, and living creatures. Getting to know sea water is a difficult task. Most oceanographic data pertain to areas some distance from the shore, but engineers are concerned with coastal and estuarine sea waters that vary in concentration composition because of dilution, biological processes, and wastes. The concentration of dissolved minerals is described in terms of abundance, salinity, chlorinity, and chlorosity. The physical properties of sea water and the general chemistry of the ocean are presented; corrosion, foaming, supersaturation, deposition of solids, fouling, and biological pests are discussed. (USBR)
W70-05224

THE EFFECT OF LIGHT ON NITRATE AND NITRITE ASSIMILATION BY CHLORELLA AND ANKISTRODESMUS,
University Coll., London (England). Dept. of Botany.
I. Morris, and J. Ahmed.
Physiologia Plantarum, Vol 22, No 6, p 1166-1174, 1969. 5 tab, 20 ref.

Descriptors: *Algae, *Light, *Nitrates, *Nitrites, Aerobic conditions, Anaerobic conditions, Chlorella.
Identifiers: Carbon dioxide, Chlorella pyrenoidosa, Ankistrodesmus braunii, Dunaliella tertiolecta, DCMU inhibitor.

Assimilation of nitrate and nitrite nitrogen by Chlorella pyrenoidosa and Ankistrodesmus braunii was observed under illumination in aerobic and anaerobic media in the absence of carbon dioxide. The presence of carbon dioxide failed to influence the assimilation of Chlorella, but stimulated that of Ankistrodesmus. The ratios of oxygen:nitrate and oxygen:nitrite varied in different trials and were higher than calculated values for oxygen of 2.0 and 1.5 expected in reduction of nitrate and nitrite, respectively. Oxygen evolution was completely arrested by 3- (3'-4'-dichlorophenyl)-1-1 dimethyl urea (DCMU) at a concentration of 0.000004M. However, nitrite assimilation by both algae and nitrate assimilation by Ankistrodesmus were less depressed by the inhibitor. (Wilde-Wisconsin)
W70-05261

THE EFFECT OF DELETERIOUS CONCENTRATIONS OF COPPER ON THE PHOTOSYNTHESIS OF CHLORELLA PYRENOIDOSA,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
E. Steemann Nielsen, L. Kamp-Nielsen, and S. Wium-Andersen.
Physiologia Plantarum, Vol 22, No 6, p 1121-1133, 1969. 7 fig, 4 tab, 13 ref.

Descriptors: *Copper sulfate, *Photosynthesis, *Chlorella, *Toxicity, Light, Hydrogen ion concentration, Potassium, Herbicides, Fungicides.
Identifiers: *Chlorella pyrenoidosa, Cytoplasmic membranes, Cell division, Skeletonema costatum.

This study, conducted under illuminated conditions, revealed that the maximum influence of copper sulfate on Chlorella pyrenoidosa is exerted during the first 24 hours of the plant's contact with the chemical. A significant depression of photosynthesis was observed at copper concentration as low as about 1 microgram/liter. A decrease of the medium reaction from pH 8 to pH 5 required a 10 times increase in copper concentration to obtain the same deleterious effect. Addition of potassium decreased the effectiveness of the herbicide and indicated that the eradicating effect of copper is not due to penetration of this ion into the plasma, but to a binding to the cytoplasmic membrane and arrested division of cells. Other cations tend also to displace copper from the active sites of the membranes. (Wilde-Wisconsin)
W70-05370

THE ADAPTATION OF PLANKTON ALGAE. IV. LIGHT ADAPTATION IN DIFFERENT ALGAL SPECIES,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
Erik G. Jorgensen.
Physiologia Plantarum, Vol 22, No 6, p 1307-1315, 1969. 4 fig, 2 tab, 15 ref.

Descriptors: *Plankton, *Algae, *Light intensity, Chlorella, Chlorophyta, Diatoms, Pigments, Chlorophyll, Photosynthesis, Growth rate, Organic matter, Scenedesmus, Chlamydomonas, Freshwater, Marine algae, Enzymes.
Identifiers: *Adaptation, *Species, Cyclotella Meneghiniana, Light-saturated rate, Cell volume, Nitzschia closterium, Nitzschia palea, Chloroplasts, Scenedesmus obliquus, Scenedesmus quadricauda, Chlorella pyrenoidosa, Chlorella vulgaris, Monodus subterraneus, Ankistrodesmus falcatus, Chlamydomonas moewusii, Skeletonema costatum, Synechococcus elongatus.

Two types of plankton algae adapt to light intensities differently--Chlorella and Cyclotella. The Chlorella type is mostly found among green algae and adapts to a new light intensity chiefly by changing the pigment content. The cells adapted to a high light intensity have a lower chlorophyll a content per cell than cells adapted to low light intensity, the latter with rather low light saturation. The light-saturated rate of photosynthesis is usually lower for cells adapted to a high light intensity than for cells adapted to a low light intensity. Actual photosynthesis (photosynthesis at the light intensity where the cells are grown) is not much higher at high light intensity than at low. The Cyclotella, prevalent among diatoms, adapts only by changing the light-saturation rate. Chlorophyll content is the same in cells grown at low and high intensities. Light saturation for cells grown at a low light intensity is rather high. The light-saturated rate is much higher in the case examined at high intensity than at low. Actual photosynthesis is considerably higher for cells grown at high light intensities opposed to low. Transitional types occur. (Jones-Wisconsin)
W70-05381

SEA SURFACE CHEMISTRY: ORGANIC CARBON AND ORGANIC AND INORGANIC NITROGEN AND PHOSPHORUS IN SURFACE FILMS AND SUBSURFACE WATERS,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
P. M. Williams.
Deep-Sea Research, Vol 14, p 791-800, 1967. 7 tab, 33 ref.

Descriptors: *Nitrogen, *Ocean water, *Air-water interfaces, *Nitrogen cycle, Nitrification, Phosphorus, Environmental effects, Microenvironment, Carbon, Nitrate, Subsurface waters, Organic matter, Chemical properties.
Identifiers: *Sea surface phenomena, Marine snow, Sea surface films, Euphotic zone, Peru, Southern California, Particulate matter.

The microenvironment of the sea surface is a few millimeters to Angstroms thick, but it is an important intermediary source, or sink, for airborne organisms and inorganic compounds. Formation and eventual fate of particles and dissolved organic matter in euphotic zones is relevant to sea surface phenomenon. From surface film, subsurface and 15-20 centimeter deep sampling off the coast of Peru and Southern California, curve concentration gradient for dissolved and particulate carbon, nitrogen, and phosphorus are reported. Nitrate was concentrated in all surface films. Bacterial nitrification is the most likely cause. Ratios between organic carbon, nitrogen and phosphorus were calculated to indicate origin of particulate organic detritus. Surface film gave no significant correspondence between nitrogen/phosphorus and carbon/nitrogen, while high nitrogen/phosphorus ratios indicated rapid phosphorus mineralization. Organic nitrogen is lost primarily by sedimentation. Because of high concentration of nitrogen as ammonium, nitrate and organic nitrogen acting as nitrogen reservoir in sea surface films, a closed system of nitrogen recycling might exist in the sea. (Bannerman-Wisconsin)
W70-05411

THE ROLE OF COAGULATION IN NATURAL WATERS,
Harvard University, Cambridge, Mass. Div. of Engineering and Applied Physics.
Hermann H. Hahn, and Werner Stumm.
American Journal of Science, Vol 268, No 4, p 354-368, April 1970. 15 p, 6 fig, 2 tab, 27 ref.

Descriptors: *Water chemistry, *Coagulation, *Flocculation, *Clays, *Clay minerals, Ions, Solutes, Deposition (Sediments), Sedimentation, Turbidity, Colloids, Chemical precipitation, Gels, Hydrosols (Dispersions), Mineralogy, Water properties, Silica, Montmorillonite, Kaolinite, Illite.
Identifiers: Colloid chemistry.

The rate of coagulation of various colloids (montmorillonite, kaolinite, illite, silica) was determined on the basis of theoretical calculations and experimental measurements in solutions of specified conditions of pH, ionic strength, or individual concentration of ions. The size of colloidal aggregates formed in a natural water within a certain time of reaction is calculated from these rates of coagulation. With this information the effects of aggregation, sedimentation, and horizontal transport of colloids in a natural body of water were discussed: the changes in the concentration and composition of the dispersed phase and the horizontal and vertical change in the pattern of sedimentation. The developed models represent first approximations and apply only within the limits of the necessary assumptions. However, they show that it is useful to apply principles of colloid chemistry in describing the composition of natural waters and underlying sediments. (Knapp-USGS)
W70-05472

MICROBIOLOGICAL ASSAYS OF SEA WATER USING RADIOISOTOPES-AN ASSAY FOR VITAMIN B-12 MEASURED BY C-14 ASSIMILATION,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
Kenneth Gold.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 341-345, 1967. 5 p, 5 fig, 14 ref. AEC Contract CU-3233-2.

Descriptors: *Bioassay, *Sea Water, *Carbon radioisotopes, *Vitamin B, Optical properties,

Analytical techniques, Microorganisms, Incubation, Radioisotopes.
Identifiers: *Microbiological assays, Cyclolella nana.

Microbiological assay methods can use radioisotopes, particularly C-14, to determine seawater constituents. In marine bioassay, great emphasis has been placed upon methods of detecting vitamin B-12. The usual method to measure the responses to varying concentrations of B-12 is to compare cell density or optical density after incubation. The diatom Cyclotella nana was used in experimental studies; preparation of external and internal standard solutions, assay and incubation methods are briefly discussed, and data are presented graphically. Sensitive responses have been obtained from 0.1 micro-microgram/liter of vitamin B-12 and it is believed that the lowest limits can be extended still further. (Carstea-USGS)
W70-05546

2L. Estuaries

ORGANIC CHELATORS: FACTORS AFFECTING PRIMARY PRODUCTION IN THE CROMWELL CURRENT UPWELLING,
Woods Hole Oceanographic Institution, Mass.
Richard T. Barber, and John H. Ryther.
Journal Experimental Marine Biology and Ecology, Vol 3, p 191-199, 1969. 2 fig, 3 tab, 15 ref.

Descriptors: *Organic matter, *Ocean circulation, *Currents (Water), Inorgnaic compounds, Nutrients, Aquatic life, Sea water, Fertility, Chelation, Primary productivity.
Identifiers: *Cromwell Current, *Pacific Ocean, Chlorophyll a, Upwelled water, Equator, Carbon-14 uptake, Ethylenediamine tetraacetic acid, Disodium-EDTA, Organic chelators.

Water from the subsurface of the Cromwell Current upwells at the equator in the eastern Pacific Ocean and spreads north and south. This water is rich in inorganic nutrients but lower in dissolved organic carbon than aged, productive water to the north and south. Enrichment experiments with the nutrient-rich, newly upwelled water did not improve photosynthesis; however, the addition of disodium-EDTA or the filtrate from an undefined zooplankton homogenate, did result in increased carbon-14-bicarbonate uptake. Non-enriched phytoplankton populations from 2 deg south, took up carbon-14-bicarbonate at a rate equal to the zooplankton extract enriched culture from 0 degree. The abundance of chlorophyll a at these stations was initially the same, emphasizing that the differences in carbon-14 uptake were due to changes in growth rate and not the initial standing crop. The data suggest that the upwelled water is limited by the absence of certain chelating substances. As the upwelled water ages, the organisms apparently gradually enrich the water with organic compounds, some of which may be effective chelators. The aged water at 2 deg S and 2 deg N contained a slightly higher dissolved organic carbon concentration and apparently a higher concentration of organic chelators. (Haskins-Wisconsin)
W70-05087

A STUDY OF POLLUTION IN THE THAMES ESTUARY,
Water Pollution Research Lab., Stevenage (England).
A. L. H. Gameson, and I. C. Hart.
Chemistry and Industry, p 2117-2123, December 17, 1966. 5 fig, 3 ref.

Descriptors: *Water pollution, *Estuaries, Dissolved oxygen, Treatment facilities, Water quality, Ammonia, Nitrogen, Temperature, Flow, Fresh water, Biochemical oxygen demand, Salinity, Sewage, Aeration, Dredging, Chlorides, Tides, Anaerobic, Detergents, Distance.
Identifiers: *Thames Estuary (England), England, Teddington (England), Greater London Council, Port of London Authority.

An investigation was begun in 1949 to provide information on which recommendations could be based for reducing the pollution of the Thames Estuary. The main objectives were to determine effects of various factors on distribution of dissolved oxygen, and to develop methods by which this distribution could be predicted for any combination of conditions that might arise. The condition of the middle (most polluted) reaches of the Thames Estuary, as judged by the dissolved oxygen content of the water, showed a marked improvement at the beginning of 1964, following the installation of the secondary treatment plant in Southern Outfall Sewage Works; this improvement was maintained throughout 1964-1965. The lower reaches have shown no improvement and satisfactory conclusions for this have not been reached as many factors are involved. Among them are deposition of organic solids, removal by dredging, changes in dredging, possible return of oxidizable matter to the estuary, variations of sampling methods, and longitudinal mixing. The marked deterioration in 1949-1950 is attributable to the widespread introduction of synthetic anionic detergents. In 1964-1965 there was no anaerobic reach established at any time, a situation that had not existed for several decades. (Jones-Wisconsin)
W70-05093

MEASUREMENT AND DETECTION OF EUTROPHICATION,
Central Coastal Regional Water Quality Control Board, San Luis Obispo, Calif.
Thomas E. Bailey.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 93, No SA6, p 121-132, 1967. 6 fig.

Descriptors: *Correlation analysis, *Fluorometry, *Fluorescence, *Chlorophyll, *Eutrophication, Primary productivity, Phytoplankton, Photosynthesis, Biomass, Cultures, Plant physiology, Algae, Diurnal distribution, Oxygen, Dissolved oxygen, Measurement, Estuaries, Sanitary engineering, Water treatment, Waste treatment.
Identifiers: Sacramento-San Joaquin Delta, California Water Plan, Delta Water Facilities (Calif), Oxygen dynamics, Sacramento-San Joaquin Estuary, Environmental relationships, Fluorometric chlorophyll technique.

Primary productivity, an important indicator of eutrophication, was measured indirectly as chlorophyll concentration of phytoplankton standing crop. Pigment concentrations were determined spectrophotometrically as absorbance with a 90% acetone solvent. Fluorescent dye tracer techniques were modified to measure chlorophyll fluorometrically. Light scattering, quenching, and variation in phytoplankton were considered to influence fluorescence measured by the Turner Model 111 Fluorometer, establishing chlorophyll as a good indicator of eutrophication based on relationship with phytoplankton standing crop and photosynthetic activity. An empirical equation was defined for estimating photosynthesis from chlorophyll data. Dependence of dissolved oxygen supersaturation on plant metabolism related diurnal oxygen concentration to chlorophyll. Fluorometric technique of measuring chlorophyll is a fast and flexible method for measuring primary environmental relationship and biological monitoring in such installations as sewage treatment plants. Once primary environmental chlorophyll relationships are defined, the fluorometric technique can be used almost without limitation. (Bannerman-Wisconsin)
W70-05094

NITROGEN TURNOVER IN MARINE AND BRACKISH HABITATS. IV. UPTAKE OF THE EXTRACELLULAR PRODUCTS OF THE NITROGEN-FIXING ALGA CALOTHERIX SCOPULORUM,
Westfield Coll., London (England). Dept. of Botany.
K. Jones, and W. D. P. Stewart.
Journal Marine Biological Association of the United Kingdom, Vol 49, No 3, p 701-716, 1969. 5 fig, 9 tab, 33 ref.

Descriptors: *Algae, *Brackish water, *Nitrogen, *Metabolism, Uptake, Adsorption, Tracers, Marine microorganisms, Fungi, Bacteria.
Identifiers: Calothrix scopulorum, Metabolic uptake, Heterotrophic bacteria, Proteolytic bacteria, Extracellular nitrogen, Nitrogen-15, Blue-green algae.

Calothrix scopulorum is a marine blue-green alga capable of fixing nitrogen and liberating large portions into the environment. Tests with laboratory cultures of algae, fungi, and bacteria, in a medium of nitrogen-15 labeled products of Calothrix scopulorum, indicated uptake of nitrogen-15 by these organisms. Uptake was also evident when alternate nitrogen sources were present. Natural C scopulorum and algae were collected and exposed to gaseous nitrogen-15 with algae again incorporating extracellular nitrogen-15 nitrogen. Uptake of extracellular nitrogen has both an active and passive mechanism. Active metabolic uptake was sometimes more significant than adsorption in passive uptake. Living cells had a higher nitrogen-15 concentration than dead cells. Organisms grew in a strict extracellular environment, but not as fast as when nitrate nitrogen was available. When labeled extracellular nitrogen was sorbed on inorganic nuclei a precipitate formed. Organisms in brackish or littoral water might use extracellular nitrogen as a sole nitrogen source. Measurements of free nitrogen species in the sea is not a true indicator of biologically important nitrogen concentration. (Bannerman-Wisconsin)
W70-05101

EUTROPHICATION OF A TIDAL ESTUARY,
Cornell Univ., Ithaca, N.Y. Dept. of Conservation.
John P. Barlow, Carl J. Lorenzen, and Richard T. Myren.
Limnology and Oceanography, Vol 8, No 2, p 251-262, 1963. 2 fig, 5 tab, 29 ref.

Descriptors: *Estuaries, *Eutrophication, *Fertilizers, Nutrients, Tidal waters, Saline water, Phosphorus, Nitrogen, Organic matter, Decomposing organic matter, Biochemical oxygen demand, Chemical oxygen demand, Photosynthesis, Oxygen, Respiration, Circulation, Fresh water.
Identifiers: Bathymetric charts, Oxygen:chlorophyll a ratio, Moriches Bay (L I - N Y), Forge River (N Y), Ultimate oxygen demand, Organic matter production, Allocthonous materials, Chlorophyll a.

Moriches Bay on Long Island, New York, has provided a dramatic illustration of eutrophication of tidal waters under the influence of heavy fertilization. Despite pronounced stratification of salinity, the nutrients carried seaward from the estuary of the Forge River do not accumulate in the deeper layer. Nearly all organic matter of the estuary was produced locally by the dense algal population, a conclusion substantiated by values for chlorophyll a, photosynthesis: respiration ratios, and the rate of oxidation of allochthonous organic matter. (Wilde-Wisconsin)
W70-05102

PHOSPHORUS CONCENTRATIONS IN THE PAMLICO RIVER ESTUARY OF NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 05C.
W70-05115

A HEAT BUDGET OF THE WATER IN BARROW STRAIT FOR 1962,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
For primary bibliographic entry see Field 02C.
W70-05136

MATHEMATICAL TIDAL STUDY OF ST. LAWRENCE RIVER,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering; and National Research Council of Canada, Ottawa (Ontario).
J. William Kamphuis.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7141, pp 643-664, March 1970. 22 p, 17 fig, 8 ref, append.

Descriptors: *Estuaries, *Tidal effects, *Mathematical models, *St. Lawrence River, Equations, Digital computers, Model studies, Water level fluctuations, Tidal waters, Tides.
Identifiers: Tidal models.

A mathematical study of the tidal motion in the St. Lawrence River and Estuary is presented. Differential equations, schematization and difference equations are analyzed and a detailed description is given of three separate difference schemes, an explicit model and two implicit ones. The solution of the large matrices resulting from the implicit schemes is detailed at length and the three schemes are compared as to their results and relative advantage. (Knapp-USGS)
W70-05157

THE CONTROL OF ESTUARINE POLLUTION,
Forth River Purification Board, Langgarth (Scotland).
W. F. Collett.
Chemistry and Industry, p 25-29, January 7, 1967.

Descriptors: *Estuaries, *Water pollution effects, *Water pollution control, Navigation, Standards, Recreation, Fisheries, Thermal water, Powerplants, Fish, Crustaceans, Self-purification.
Identifiers: Scotland, Britain, Comprehensive pollution control, River Forth (Scotland), River Clyde (Scotland).

Scotland's views on comprehensive control of effluent discharges into estuaries are outlined. Control methods to achieve water quality suitable for various purposes are described and the following conclusions are drawn: full committal to the self-purification capacity of an estuary is impractical; estuaries should be divided into zones where discharges are subject to similar limitations, or more practically, on equality of effort rather than results; with wide margin of safety attached to pollution limitation, a complete knowledge of the self-purification capacity of an estuary is unnecessary before controls are applied; discharge of effluents must be controlled for the benefit of the estuary; control should be primarily for the current use of an estuary; remedial work should be phased according to availability of funds and expertise; priority must be given to those discharges which by their size, strength, or situation are the dominating factors in estuarine pollution; and if estuarine usage is to be maximal, the consideration is not how little need be done to improve effluents but how much can be required without excessive hardship to any segment of industry or the community. (Haskins-Wisconsin)
W70-05262

AMINO ACID FLUX IN AN ESTUARY,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Virginia Inst. of Marine Science, Gloucester Point.
John E. Hobbie, Claude C. Crawford, and Kenneth L. Webb.
Science, Vol 159, p 1463-1464, March 1968. 1 tab, 10 ref.

Descriptors: *Amino acids, *Estuaries, *Absorption, Organic matter, Virginia, Aquatic bacteria, Physiological ecology, Phytoplankton, Photosynthesis, Carbon radioisotopes, Regression analysis, Kinetics, Lakes, North Carolina.
Identifiers: Substrate concentration, Turnover time, Maximum uptake velocity, Transport affinity constant, Uptake velocity, Heterotrophy, Isoleucine, Virginia Institute of Marine Science, Ornithine, Histidine, Arginine, Organic solutes, York River (Va), Glycine, Serine, Microbial ecology, Methionine, Radiocarbon uptake techniques, Dissolved free amino acids, Technicon Auto Analyzer, Lineweaver-Burk equation, Aspartic acid, Threonine, Alanine, Pamlico River (NC), Transport systems, Glutamic acid, Valine, Cary electrometer, Leucine, Lysine, Tyrosine, Proline, Phenyl alanine.

Assessment of the role in heterotrophy of specific organic solutes in the hydrosphere requires knowledge not only of their instantaneous concentrations, but also of their flux through the ecosystem. Useful ecological parameters can be derived from kinetic analysis of uptake by aquatic microbiota (particularly bacteria) of radiocarbon-labeled organic substrates. Analysis for dissolved free amino acids (DFAA) in York River (Virginia) estuary revealed presence of 17, for total concentration of 38 micrograns/liter, data consistent with values reported for open ocean, other estuaries, and lakes. In highest concentrations (reported as micrograns/liter) were glycine (16.85), serine (4.91), ornithine (3.17). Kinetic analysis of uptake by planktonic bacteria of 14 amino acids showed highest flux rates (micrograms/liter per hour) for glycine (0.423), methionine (0.171), and serine (0.133). Because these data need correction for respired carbon, true flux values may be 2-fold greater. Based on these data, and others for photosynthesis, fluxes represent 1 to 10% of daily photosynthetic carbon fixation. Although methionine and threonine are present in similar concentrations, methionine moved through DFAA pool 8-fold faster than threonine, illustrating ecological importance of information of dynamic properties of the system. (Eichhorn-Wisconsin)
W70-05271

FACTORIAL PRODUCTIVITY EXPERIMENTS IN A SHALLOW ESTUARY: ENERGETICS OF INDIVIDUAL PLANKTON SPECIES IN MIXED POPULATIONS,
Oak Ridge National Lab., Tenn.
Bernard C. Patten, and George M. Van Dyne.
Limnology and Oceanography, Vol 13, No 2, p 309-314, 1968. 1 fig, 1 tab, 8 ref.

Descriptors: *Plankton, *Estuaries, *Productivity, Energy, Population, Photosynthesis, Respiration, Oxygen requirements.
Identifiers: Skeletonema costatum, York River (Va), Nonlinear programming, Least squares analysis, Light-dark bottle technique.

Estimates of specific plankton population productivity parameters from water samples containing mixed species were made by means of nonlinear programming. An illustration of the method is provided by specimen data relevant to in situ populations of Skeletonema costatum, inhabiting York River, Virginia. Observation of changes in the estimated energy-processing characteristics of this diatom suggested that the organism possesses a wide physiological adaptation. Computed gross production and respiration were correlated positively; estimates of individual's productive output were inversely related to corresponding values for other species, suggesting interspecific competition. An appraisal of the accuracy of obtained results will require direct determinations. (Wilde-Wisconsin)
W70-05273

UNDERWATER LASER SURVEYING SYSTEM,
TRW Systems Group, Redondo Beach, Calif.
For primary bibliographic entry see Field 07B.
W70-05318

THE ACCURACY OF PRESENT WAVE FORECASTING METHODS WITH REFERENCE TO PROBLEMS IN BEACH EROSION ON THE NEW JERSEY AND LONG ISLAND COASTS,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
Willard J. Pierson, Jr.
Available from the Clearinghouse as PB-106 577, $3.00 in paper copy, $0.65 in microfiche. Technical memo., Apr. 51, 83 p., Rept no. TM-24.

Descriptors: *Beaches, Erosion, *Ocean waves, Predictions, Altitude, Accuracy, Seacoast, New Jersey, New York.
Identifiers: Beach erosion, Long Island (New York), Long Branch (New Jersey).

Detailed weather data and wave data for every four hours were obtained from 22 April 1948 to 31 May 1948. An attempt was made to fit the observed significant height and significant period to the forecasted significant height and significant period within the range of accuracy of the weather data. It was, in general, possible to obtain good agreement between the observed and forecasted significant heights.
W70-05319

AN ANALYSIS OF MARINE CORER DYNAMICS,
Navy Underwater Sound Lab., New London, Conn.
For primary bibliographic entry see Field 07B.
W70-05378

OSMOTIC ACCOMMODATION IN CALLINECTES SAPIDUS RATHBUN,
Gulf Coast Research Lab., Ocean Springs, Miss.; and Mississippi State Univ., State College. Dept. of Zoology.
Buena S. Ballard, and Walter Abbott.
Comparative Biochemistry and Physiology, Vol 29, p 671-687, 1969. 5 fig, 3 tab, 43 ref.

Descriptors: *Crabs, *Physiological ecology, *Estuaries, Salt tolerance, Amino acids, Salinities, Mississippi, Migration patterns, Animal behavior, Environmental effects.
Identifiers: *Callinectes sapidus, *Osmoregulation, Blue crabs, Temperature effects, Salinity effects, Euryhalinity, Ninhydrin-reactive substances, Hyporegulation, Hyperregulation, Melting time techniques, Freezing point osmometry, Blood osmoconcentrations, Mississippi Sound, Pascagoula River (Miss), Homoiosmoticity, Iso-osmoticity, Osmotic work, Bluff Creek (Miss), Gulf Coast Research Laboratory, Ocean Springs (Miss).

Salinity-correlated, sexually differentiated migratory patterns, which may be physiologically or behaviorally caused, occur in blue crabs (Callinectes sapidus), a euryhaline species. In adult crabs, ambient salinity and temperature influence blood osmoconcentrations, as determined from melting times or freezing point osmometry. Crabs demonstrated good hyperregulation at low salinities; were approximately homoiosmotic at salinities in range 20-25 parts/thousand (ppt); and approached iso-osmoticity at higher salinities. Hyporegulation occurs only at high temperature (28-30C). Blood osmoconcentration varies inversely with temperature, seasonal effects (apparently due to environmental temperature at which animals are collected) persisting under thermally constant experimental conditions. In a range of salinities, approximately 1-20 ppt, blood osmoconcentrations are lower in males than in females, steeper osmotic gradient in latter apparently requiring greater energy expenditure for regulation. When animals of either sex are changed to a new ambient salinity, post-acclimation osmoconcentration of their blood is greater after change from high to low salinity than after converse change. Hemoconcentration of total organic substances, including those reacting as amino acids, vary independently of blood osmoconcentration, whereas inorganic substances vary similarly, suggesting that latter are responsible for osmoregulation. (Eichhorn-Wisconsin)
W70-05383

THE MOLECULAR NATURE OF ORGANIC MATTER IN LAKES AND OCEANS, WITH

LESSER REFERENCE TO SEWAGE AND TERRESTRIAL SOILS,
Queen's Univ., Kingston (Ontario).
For primary bibliographic entry see Field 02I.
W70-05395

STANDING CROP OF FORAMINIFERA IN SUBLITTORAL EPIPHYTIC COMMUNITIES OF A LONG ISLAND SALT MARSH,
City Coll., New York. Dept. of Biology; Queens Coll., Flushing, N.Y. Dept. of Science Education; and Pace Coll., New York. Dept. of Biology.
J. J. Lee, W. A. Muller, R. J. Stone, M. E. McEnery, and W. Zucker.
Marine Biology, Vol 4, No 1, p 44-61, 1969. 7 fig, 18 tab, 53 ref.

Descriptors: *Aquatic life, *Crustaceans, *Standing crop, Epiphytology, Distribution, Ecotypes, Marshes (Salt), Methodology, Ammonia.
Identifiers: *Foraminifera, Species diversity, Diversity indices, Zostera, Enteromorpha, Ulva, Polysiphonia, Protelphidium, Quinqueloculina, Elphidium.

Foraminifera showed a seasonal shift in abundance in epiphytic communities, being most abundant on Enteromorpha in early summer and later shifting to communities on Zostera, Ulva, and other aquatic plants. Foraminiferans were rarely found on Fucus or Codium. Some foraminiferan species showed substrate preferences. A general increase in numbers of foraminiferans occurred as summer progressed, with a trend toward greater species diversity in late July to early August. Decaying vegetation had greatest standing crop and lowest species diversity indices; diversity indices for foraminiferan communities on various aquatic plants varied from 0.196 to 0.990 (formula for computing diversity is not given). Probability and coincidence tables were constructed to test independence of distribution of foraminiferan species; results suggest several species have common microenvironmental dependence. Both positive and negative correlations of species distributions were noted. Tabular data include probability and coincidence tables and results of coincidence analysis; figures include photographs of 22 species of foraminifera. (Voigtlander-Wisconsin)
W70-05413

TIDAL INLETS AND WASHOVER FANS,
Smithsonian Institution, Washington, D.C. Div. of Sedimentology.
J. W. Pierce.
Journal of Geology, Vol 78, No 2, p 230-234, March 1970. 7 p, 1 fig, 1 plate, 10 ref. NSF Grant G-16362. SRF Grant RA-3307.

Descriptors: *Sedimentation, *Sediment transport, *Deposition (Sediments), *Inlets (Waterways), *Estuaries, Deltas, Regime, Channel morphology, Coasts, Geomorphology, Alluvium, Alluvial channels, Waves (Water), Beach erosion, Surf, North Carolina.
Identifiers: Washover fans, Cape Hatteras.

Tidal inlets and washover fans are genetically related and dependent upon barrier configuration, depths in the lagoon adjacent to the barrier, and the direction from which storm surges come, either from the sea or the lagoon. Attack on barrier islands from the seaward side by waves overtopping the barrier will result in washover fans on wide barriers where extensive adjoining tidal flats are present. Inlets can be cut by this type attack on narrow barriers where no tidal flats are present. Storm surge from the lagoonal side, if channeled along tidal creeks, can easily cut inlets through a barrier. (Knapp-USGS)
W70-05474

SUBMARINE CANYON ORIGIN ON UPPER CONTINENTAL SLOPE OFF CAPE HATTERAS,
Atlantic Oceanographic and Meteorological Labs., Miami, Fla.
Peter A. Rona.
Journal of Geology, Vol 78, No 2, p 141-152, March 1970. 12 p, 7 fig, 2 tab, 44 ref. ONR Contract Nonr-266 (84).

Descriptors: *Canyons, *Underwater, *Erosion, *Deposition (Sediments), *Geomorphology, Ocean currents, Waves (Water), North Carolina, Sounding, Seismic studies, Hydrography, Oceanography.
Identifiers: Cape Hatteras, Submarine canyons.

The configuration of sedimentary strata revealed by continuous seismic-reflection profiles over submarine canyons on the upper continental slope off Cape Hatteras is best explained by the hypothesis of composite origin of submarine canyons. The canyons were originally incised into a post-Miocene surface of unconformity. The intercanyon areas were constructed by deposition of sediment up to several hundred meters thick forming the canyon walls while the canyons were maintained by sediment removal processes over the sites of original incision. Canyon heads are presently buried under a smooth sediment cover which extends from the shelf break at about 90 m down to about 400 m below sea level, where the canyons emerge from the cover. The depth of emergence of canyons approximately coincides with the inferred level of no motion between the northeast-flowing Florida Current and the southwest-flowing Western Boundary Undercurrent. (Knapp-USGS)
W70-05476

QUANTITATIVE ANALYSIS OF BEACH SAND MOVEMENT, VIRGINIA BEACH, VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 02J.
W70-05520

COMPACTNESS VARIABILITY OF ESTUARINE SEDIMENTS: AN IN SITU STUDY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
Robert L. McMaster.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 261-267, 1967. 7 p, 7 fig, 7 tab, 11 ref. ONR Contract Nonr 396 (02).

Descriptors: *Compaction, *Estuaries, *Sediments, Sedimentation, Sands, Soil texture, Particle size, Water temperature, Pressure, Biological properties, Chemical properties.
Identifiers: Estuarine sediments.

Experimental studies reveal that regardless of season or water temperature the compaction behavior of sediments is determined by the textural and compositional properties of the particular sediment. The average slope of pressure versus time curves depends on sand content. The variation of sediment compactness with water temperature is believed to be due to subsequent changes in biological, chemical, and biochemical activities rather than the actual changes in water temperature. (Carstea-USGS)
W70-05541

OBSERVATIONS OF CIRCULATION IN COASTAL PLAIN ESTUARIES,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
Donald W. Pritchard.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 37-44, 1967. 8 p, 7 fig, 10 ref.

Descriptors: *Water circulation, *Estuaries, Stratification, Classification, Model studies, Water properties, Water chemistry, Physical properties, Salinity.
Identifiers: *Estuarine circulation, Stratified estuaries.

There are 4 principal classes of coastal plain estuaries which differ in the character of circulation patterns, in the intensity of vertical stratification, and in the extent of lateral homogeneity. The character of estuarine circulation patterns is briefly described for the highly stratified, moderately stratified, and vertically homogeneous estuaries. Circulation in a highly stratified estuary is discussed for a frictionless model and in a non-tidal model. Direct observations of the distribution of chemical and physical properties, and other direct and indirect measurements are discussed. (Carstea-USGS)
W70-05542

METHODS AND DEVICES FOR MEASURING CURRENTS,
Marine Advisers, La Jolla, Calif.
For primary bibliographic entry see Field 07B.
W70-05543

GEOMORPHOLOGY AND COASTAL PROCESSES,
Cambridge Univ. (England). Dept. of Geography.
J. A. Steers.
In: Estuaries, Publication No 83, American Association for the Advancementof Science, Wash, D C, p 100-107, 1967. 8 p, 8 fig, 15 ref.

Descriptors: *Estuaries, *Coasts, Deltas, Scour, Mud, Salt marshes, Channels, Sea level, Rivers, Erosion, Waves (Water), Dredging.
Identifiers: *England, *Wales, Ribble estuary, Dee estuary, Mersey estuary, Thames estuary.

Geomorphology and coastal processes are discussed for estuaries in England and Wales. The Ribble and Dee estuaries on the west coast are rapidly becoming deltas. In contrast, natural scouring has kept the Mersey estuary open. The history of the Humber and the Wash estuaries of the east coast is traced on the basis of the work of archeologists, botanists, geographers, and historians. In both the Humber and the Wash the mud and other deposits are gradually covered by salt marsh plants. The buried channels indicate changes of the relative levels of land and sea. The Thames estuary is in a part of Britain which is slowly sinking, relative to sea level. The Thames needs constant dredging to be kept open for traffic. The influence of wind and waves upon the processes of accretion and erosion is briefly summarized. (Carstea-USGS)
W70-05544

ORIGINS OF ESTUARIES,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
Richard J. Russell.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 93-99, 1967. 7 p, 2 fig, 19 ref.

Descriptors: *Estuaries, *Tidal effects, *Tidal waters, Tides, Sea level, Ice, Glaciation, Quaternary period, Deltas, Coasts, Lakes.
Identifiers: Lake Atchafalaya, Amazon deltaic plain, Maeander Delta.

Estuaries are relatively new features of the earth's surface. The estuaries were initiated during the recent rise of the sea levels with a peak of development occurring about 3000 years ago. A taxonomic classification of estuaries is unjustified because knowledge of coastal features is incomplete. Examples of different estuaries from all over the world are given. Estuaries are headed for rapid extinction by delta formation and advancement. Lake Atchafalaya, the Amazon deltaic plain, and the Maeander Delta are discussed in order to emphasize the ephemeral nature of most estuaries. (Carstea-USGS)
W70-05545

MICROBIOLOGICAL ASSAYS OF SEA WATER USING RADIOISOTOPES-AN ASSAY FOR VITAMIN B-12 MEASURED BY C-14 ASSIMILATION,
Lamont-Doherty Geological Observatory, Palisades, N.Y.

For primary bibliographic entry see Field 02K.
W70-05546

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING SALINE GROUNDWATER FOR IRRIGATION PURPOSES - A CASE STUDY, BUCKEYE AREA, COLORADO RIVER BASIN, U.S.A.,
Bureau of Reclamation, Denver, Colo., Bureau of Reclamation, Nev.; and Office of Saline Water, Washington, D.C.
Harold L. Parkinson, John T. Maletic, Joseph P. Wagner, and Milton S. Sachs.
Paper presented at Symposium on Saline Water - A Valuable Resource, American Geophysical Union, Wash, D C, Apr 24, 1969. 26 p, 6 fig, 11 tab, 17 ref. Agreement No 14-01-0001-1241 USDI.

Descriptors: *Desalination, *Irrigation water, *Groundwater, Saline water, Arizona, Cost-benefit analysis, Economics, Desalination processes, Distillation, Electrodialysis, Costs, Water costs, Cost-benefit ratio, Feasibility studies.
Identifiers: Buckeye (Ariz).

A study was made of an irrigated area in Arizona to evaluate costs and benefits associated with desalting saline groundwater from seven wells as an improved water source for irrigation. Both multistage flash distillation (MSF) and electrodialysis (ED) processes were evaluated. Well water quality varied from 1,580 to 4,600 ppm. Irrigation water qualities of 400, 900, and 1,500 ppm are developed by the two processes. Benefit-cost ratios increased with improved water quality. Investment costs per acre were found to be high. The most favorable benefit-cost ratio involved utilization of the ED process at a water quality level of 400 ppm. (Knapp-USGS)
W70-05074

THE USE OF AMALGAM ELECTRODES TO MEASURE ACTIVITY COEFFICIENTS OF METAL SALTS IN MULTICOMPONENT SALT SOLUTIONS,
Tyco Labs., Inc., Waltham, Mass.
James N. Butler, and Rima Huston.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.25. Office Saline Water Research and Development Progress Report No 486, September 1969. 142 p, 28 fig, 20 tab, 62 ref. OSW Contract No 14-01-0001-607.

Descriptors: *Salts, *Desalination processes, *Research and development, Sodium chloride, Acids, Carbonates, Model studies, Ions, Selectivity, Electrodes, Computer programs, Solutes, Theoretical analysis.
Identifiers: *Activity coefficients, Amalgam electrodes, Glass electrode, Sodium bicarbonate.

The importance of activity coefficient measurements to the development and engineering of desalination processes is discussed. An outline of the research program and a list of abstracts of ten published papers resulting therefrom are given. Unpublished work carried out during the past year is described in detail, and includes measurements of the activity coefficient of NaCl in electrolytes containing sodium bicarbonate and sodium carbonate, studies of acid-base equilibria of carbonate systems in the presence of NaCl, and a theoretical analysis of the above data in terms of an ion-pairing model. Sodium selective glass electrodes are shown to give quite accurate measurements of activity coefficients for NaCl mixtures with KCl and to retain thin selectivity at high ionic strengths. The amalgam electrode method is shown to be much more accurate than glass electrode measurements in solutions containing bicarbonate. The computer programs used for calculations described in the report are given. (Carstea-USGS)
W70-05077

SOLUBILITIES OF SOME SILICATE MINERALS IN SALINE WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
For primary bibliographic entry see Field 02K.
W70-05078

ECONOMICS OF SEAWATER DESALTING IN COMBINATION WITH AMMONIA AND POWER PRODUCTION,
Bresler Chemical Engineering Associates, New York.
Sidney A. Bresler.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $3.00. Office Saline Water Research and Development Progress Report No 458, August 1969. 145 p, 22 fig, 22 tab, 18 ref, 2 append. OSW Contract No 14-01-0001-1485.

Descriptors: *Economics, *Desalination processes, *Desalination plants, Sea water, Distillation, Ammonia, Operating costs, Cost analysis, Nuclear energy, Fuels, Electric power, Natural gas.
Identifiers: *Multistage flash distillation.

The feasibility of lowering the operating cost of producing desalted water by combining its production with ammonia and electricity was examined. The cost of producing desalted water from sea water in a single-purpose multistage flash distillation (MSF) plant can be reduced almost 30% by combining its production with that of ammonia, to about 27 to 35 cents per thousand gallons in plants of capacities ranging from 12.5 to 180 MGD. The use of a common energy center permits the design of plants having a wide range of relative capacities of ammonia, desalted water and/or electric power, resulting in further possible reductions of unit water costs. The use of nuclear energy starts to become economically attractive when the cost of natural gas or other hydrocarbon fuel exceeds 25 cents per million Btu. (Carstea-USGS)
W70-05079

REVERSE OSMOSIS TUBULAR MODULE OPTIMIZATION,
Philco-Ford Corp., Newport Beach, Calif.
John L. Richardson, Gilbert Segovia, William Baerg, and Martha L. Anderson.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $2.00. Office Saline Water Research and Development Progress Report No 455, December 1969. 242 p, 86 fig, 38 tab, 35 ref. OSW Contract No 14-01-0001-1438.

Descriptors: *Reverse osmosis, *Desalination processes, *Membranes, *Membrane processes, Optimization, Saline water, Temperature, Pressure, Flow rates, Salts, Reynolds number, Permeability, Costs.
Identifiers: *Tubular cellulose acetate membranes.

The permeation properties of tubular cellulose acetate membranes were measured with respect to membrane fabrication conditions, saline feed solution type and concentration level, inlet pressure, inlet temperature, inlet flow rate, surface-active feed additive concentration, and time. These membranes were most sensitive to salt type and pressure and least sensitive to salt concentration level. A model of tubular module system performance was formulated using permeation property data. The maximum performance was obtained with the smallest diameter tubes in a module designed for variable number and variable membrane tightness. Increases in integrated performance of about 20% can result in a reduction of total operating cost of more than 10%. The film theory model was found to adequately represent the variation in performance with flow rate for Reynolds numbers greater than approximately 5000. (Carstea-USGS)
W70-05080

RESEARCH ON PIEZODIALYSIS,
Ionics, Inc., Watertown, Mass.
F. B. Leitz, S. S. Alexander, and A. S. Douglas.
Available from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.25. Office Saline Water Research and Development Progress Report No 452, July 1969. 147 p, 14 fig, 72 tab, 4 append. OSW Contract No 14-01-0001-611.

Descriptors: *Desalination processes, *Membranes, *Ion transport, Ion exchange, Selectivity, Hydraulic properties, Resins, Aqueous solutions.
Identifiers: *Piezodialysis, Polyethylene membranes.

Piezodialysis is a new coupled-transport process for removing ionic constituents from an aqueous solution. The conditions under which practical piezodialysis could occur and preparation of membranes were investigated. The work was primarily directed to the study of masaic ion exchange membranes consisting of small regions of anion selective material interspersed with small regions of cation selective material. The topological, electrical, hydraulic, and electrokinetic properties of membranes were measured. Styrenized polyethylene membranes did not have the best transport properties but they were capable of withstanding application of 1500 psi pressure difference. More research is recommended for developing resins which can withstand pressure but also have good transport properties. (Carstea-USGS)
W70-05081

VACUUM FREEZING VAPOR COMPRESSION DESALTING STATE-OF-THE-ART (1968).
Hittman Associates, Inc., Columbia, Md.

Available from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price 65 cents. Office of Saline Water Research and Development Progress Report No 491, October 1969. 57 p, 16 fig, 7 tab, 17 ref.

Descriptors: *Freezing, *Vapor compression distillation, *Desalination processes, Economics, Costs, Design, Sea water, Brackish water, Scaling, Temperature, Pressure, Melting, Desalination plants.
Identifiers: *Vacuum freezing.

The state of vacuum freezing-vapor compression (VFVC) technology is evaluated and analyzed, considering process theory, design, and economic cost. The VFVC process is a feasible, reliable process for desalting brackish and sea waters. No chemical treatment is required to control scale formation. The cost of a 100,000 GPD unit operating on sea water is less than $3.00 per GPD of installed capacity. A 100,000 GPD VFVC plant is commercially available. These plants will be improved by using the direct melting concept which allows the main aspects of the desalting process to be performed in one vessel. This improvement will reduce the operating cost of the process. (Carstea-USGS)
W70-05167

THE ROLE OF DESALTING TECHNIQUES,
California Univ., Los Angeles. Water Resources Center.
Aland D. K. Laird.
Report No. 16, Univ. of Calif., Los Angeles, Calif. Water Resources Center, p. 29-34, Dec. 1969, 6 p.

Descriptors: *Desalination, *Separation techniques, Costs.
Identifiers: Imperial Valley Project.

Desalination of water creates new water supplies and often serves a parallel need for electricity. At present, salt water is best demineralized by distillation. Such water is unnecessarily pure and can be used to dilute brackish waters to acceptable salinities, which provides important economies in the use of money and water. All methods of saline con-

version generate pure water and a waste brine. Several methods of desalination are discussed: freeze separation, electrodialysis, reverse osmosis, and distillation. The costs of these various processes are presented. Future developments are discussed. The project at Imperial Valley, California, is examined. (See W70-05276). (Grossman-Rutgers)
W70-05279

DEVELOPMENT OF HOLLOW FILAMENT TECHNOLOGY FOR REVERSE OSMOSIS DESALINATION SYSTEMS,
Monsanto Research Corp., Durham, N.C.
T. A. Orofino.
Office of Salina Water Research and Development Report No. 549, 1970, 178 p. OSW Contract 14-01-0001-1720.

Descriptors: *Desalination, *Reverse Osmosis, *Membranes, Membrane processes, Hollow fibers, Solution-spinning.

Hollow fine fibers for reverse osmosis desalination systems were prepared from cellulose acetate, other cellulose derivatives, poly (vinyl alcohol) compositions, and aliphatic polyamides. Investigation of the transport properties of these and other candidate materials in membrane form provided the required background for hollow fiber selection and preparation. A major accomplishment was the development of unique solution-spinning techniques for cellulose acetate systems which resulted in the successful translation of the Loeb skin-matrix composition to hollow fiber geometry. Performance indices established in field tests with 50 and 150 gpd modules include 4 gfd and 97% rejection on Webster, South Dakota water at 250 psi with 50% recovery. Flux stability was excellent. (Mintz-Office of Saline Water)
W70-05455

CONCEPTUAL DESIGNS OF OUTFALL SYSTEMS FOR DESALTING PLANTS,
Dow Chemical Co., Midland, Mich.
M. A. Zeitoun, W. F. McIlhenny, and R. O. Reid.
Office of Saline Water, Research and Development Progress Report No. 550, April 1970, 139 p. OSW Contract 14-01-0001-2169.

Descriptors: *Brine disposal, *Saline water, *Water pollution, Waste disposal, *Thermal pollution, Effluents, Outlets, Desalination.
Identifiers: *Marine ecology, *Effluent dispersion, Diffusers, Conceptual designs, Cost estimates, Outfall systems.

Design concepts of outfall systems from coastal desalting plants were developed based on both experimental and theoretical analyses of the dispersion of dense jets of various configurations. The modes of injection studied were: vertical submerged, vertical reaching the surface, and inclined at angles of 30 deg, 45 deg, and 60 deg from the horizontal. A computer program was developed to allow calculation of the effluent properties and flow rates from desalting plants of different sizes at different concentration factors and performance ratios for given ambient conditions. For each design case, the required dilution of copper concentration in the mixed effluent to a value of 0.02 milligrams per liter was calculated and used as the criterion for the design of the diffuser. Diffuser design charts were developed for 2, 5, 10 and 50 million gpd plants. Conceptual designs and cost estimates were made for the above four sizes of plants. (Gransee-Office of Saline Water)
W70-05456

THE MECHANISM FOR FORMATION OF 'SKINNED' MEMBRANES: I. STRUCTURE AND PROPERTIES OF MEMBRANES CAST FROM BINARY SOLUTIONS,
Hydronautics, Inc., Laurel, Md.
R. Bloch, and M.A. Frommer.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price 50 cents. Office Saline Water Research and Development Progress Report No 499, p 6-16, December 1969. 11 p, 3 tab, 6 ref. OSW Grant No 14-01-0001-1706.

Descriptors: *Desalination processes, *Membranes, *Membrane processes, Cellulose, Temperature, Porosity, Saline water, Salts, Solvents, Permeability, Selectivity, Filtration.
Identifiers: *Skinned membranes, Binary solutions, Cellulose acetate, Triethyl phosphate (T.E.P.), Dimethyl formamide (D.M.F.), Dimethyl sulfoxide (D.M.S.O.), Aceton, Dioxane.

The nature of the casting solvent used can determine the structure and desalination properties of cellulose membranes made from binary solutions. Membranes cast from acetone and dioxane are dense and structurally homogeneous. Membranes cast from T.E.P. are also structurally homogeneous but porous, and do not reject salt. 'Skinned' membranes consisting of a dense cellulose acetate layer supported by a porous substructure were obtained from acetic acid, D.M.F. or D.M.S.O. The skin forms at the air-cast-solution interface when acetic acid is used as the solvent. When D.M.F. or D.M.S.O. are used as solvents, the skin is located at the supported interface. The porosity of cellulose acetate membranes decreases considerably when annealed at temperatures higher than 90 deg C. (See also W70-05514). (Carstea-USGS)
W70-05513

THE MECHANISM FOR FORMATION OF 'SKINNED' MEMBRANES: II. EQUILIBRIUM PROPERTIES AND OSMOTIC FLOWS DETERMINING MEMBRANE STRUCTURE,
Hydronautics, Inc., Laurel, Md.
M. A. Frommer, I. Feiner, O. Kedem, and R. Bloch.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price 50 cents. Office Saline Water Research and Development Progress Report No 499, p 17-33, December 1969. 4 fig, 1 tab, 20 ref. OSW Grant No 14-01-0001-1706.

Descriptors: *Desalination processes, *Membranes, Membrane processes, Osmosis, Osmotic pressure, Flow, Cellulose, Solvents, Equilibrium.
Identifiers: *'Skinned' membranes, *Cellulose acetate membrane.

The critical water concentrations required to initiate the precipitation of cellulose acetate from 20% solutions in acetone, acetic acid, triethyl phosphate, dimethyl formamide and dimethyl sulfoxide have been measured. The direction and magnitude of flow through a porous cellulose acetate membrane was also determined. The concentration of nonsolvent required for precipitating cellulose acetate and the direction and magnitude of osmotic flows correlated with the volume concentration of the polymer at the precipitation point. A mechanism is suggested to explain the direction and magnitude of flows based on the formation of each membrane layer. (See also W70-05513). (Carstea-USGS)
W70-05514

MULTISTAGE FLASH DISTILLATION DESALTING STATE-OF-THE-ART (1968).
Hittman Associates, Inc., Columbia, Md.

Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.25. Office of Saline Water Research and Development Progress Report No 490, October 1969. 138 p, 40 fig, 24 tab, 48 ref.

Descriptors: *Desalination plants, *Desalination processes, *Distillation, Evaporation, Design, Costs, Cost analysis, Evaporators, Economics, Desalination plants.
Identifiers: Multistage flash distillation.

The design and economics of multistage flash desalting plants utilized in both single and dual purpose modes of operation over a range from 1 to 150 MGD were evaluated. Multistage flash evaporation plants can currently be built with performance ratios in excess of 14 pounds of product water per 1000 Btu's of heating steam. However, at present technological levels, performance ratios of about 9-11 pounds per 1000 Btu result in minimum water cost. About 40-60% of the installed plant capital cost is related to the evaporator tube bundles and shell. Most of the future reductions in water cost from the MSF process will come from improvements in material and process design. (Carstea-USGS)
W70-05515

PRELIMINARY PROCESS DEVELOPMENT STUDIES FOR DESULFATING GREAT SALT LAKE BRINES AND SEA WATER,
Bureau of Mines, Salt Lake City, Utah. Salt Lake City Metallurgy Research Center.
D'Arcy R. George, J. M. Riley, and Laird Crocker.
Bureau of Mines Report of Investigations 6928, 1967. 34 p, 11 fig, 13 tab, 8 ref.

Descriptors: *Water chemistry, *Brines, *Sulfates, *Great Salt Lake, Chemical precipitation, Salinity, Mineral industry, Water utilization, Natural resources, Saline water, Water resources development.
Identifiers: Sulfate removal, Brine mineralogy.

A process developed for removing sulfate from Great Salt Lake brines and other natural brines, including sea water is described. Sulfate is quantitatively removed by precipitation as barium sulfate in a cyclic process employing ion-exchange techniques. Barium is continuously recovered and recycled, and sodium carbonate and sulfur or sulfuric acid are produced as byproducts in quantities sufficient to more than defray the cost of desulfation. This process has favorable economic benefits which could lead to significant cost reduction in producing fresh water from sea water. (Lang-USGS)
W70-05536

3B. Water Yield Improvement

EVAPORATION NORMS FROM WATER RESERVOIRS,
State Hydrological Inst., Moscow (USSR).
For primary bibliographic entry see Field 02D.
W70-05056

A STUDY OF THE EFFECTS OF WAVES ON EVAPORATION FROM FREE WATER SURFACES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
For primary bibliographic entry see Field 02D.
W70-05208

THE SILVER IODIDE GENERATOR AND PUBLIC HEALTH,
Bureau of Reclamation, Denver, Colo.
William J. Douglas.
Preprint 1060, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 16 p, 14 ref, 2 append.

Descriptors: *Silver iodide, Cloud seeding, *Toxicity, *Safety, Carbon monoxide, Lead compounds, Potable water, Air pollution, Water pollution, Automobiles, Concentration, Nitrogen compounds, *Health, *Public health, Atmospheric precipitation, Hazards, Adsorption, *Weather modification.
Identifiers: *Silver iodide generators, Toxicants, Public Health Service, Iodide, Acetone, Exhaust gases.

Exposure of the operator of a cloud seeding generator is compared with threshold limits for prolonged exposure established by the American

Conference of Governmental Industrial Hygienists. For silver iodide and its complexes, iodine and carbon monoxide, maximum exposure was below hazardous levels. Concentrations of silver and iodine in precipitation from seeded storms were below permissible levels set by the US Public Health Service for drinking water. The inoffensive nature of the effluent from a silver iodide generator is emphasized by contrasting its chemical content with that of automobile exhaust. (USBR)
W70-05211

STATISTICAL EVALUATIONS OF A CLOUD-SEEDING PROGRAM AT THE STREAMFLOW CONTROL LEVEL,
Washington State Univ., Pullman; and State of Washington Water Research Center, Pullman.
For primary bibliographic entry see Field 02A.
W70-05221

CROP RESPONSES TO RAINFALL MULTIPLIERS,
Nebraska Univ., Lincoln. Agricultural Experiment Station.
H. D. Wittmuss, and P. L. Ehlers.
American Society of Agricultural Engineers, Transactions, Vol 11, No 4, p 484-486, July-August 1968. 1 fig, 4 tab, 7 ref.

Descriptors: *Water harvesting, *Water utilization, *Crop response, *Irrigation efficiency, *Semiarid climates, Great Plains (Nebr), Sorghum, Wheatgrass, Crop production, Soil-water-plant relationships, Rainfall, Bench leveling, Slopes, Water yield improvement.
Identifiers: *Rainfall multipliers, *Sealed contributing areas.

In a study of water-use efficiency in a semiarid area of Nebraska, rainfall multipliers were installed. They consisted of sealed contributing areas on a 3% slope above level bench areas. The increased available water was used on grain sorghum and intermediate wheatgrass plots. With 100, 150, 200, and 250 percent of rainfall availability, the sorghum plots yielded 3.9, 3.6, 3.2, and 2.8 bu per acre-inch of water, respectively (1963). The grain yield was highest on the 150 percent plot. With 100, 150, 200, and 250 percent of rainfall availability, the wheatgrass plots yielded 130, 140, 171, and 148 lb of hay per acre-inch of water, respectively (1964-66). In 1966 irrigated plots of wheatgrass produced 50 percent more hay than any rainfall multiplier plot during the three-year period. However, the plots receiving 200 percent rainfall in 1965 produced as much hay per unit of water as the irrigated plots. Further studies are needed to improve water harvesting and efficient water utilization in semiarid areas such as the Great Plains. (Carr-Arizona)
W70-05296

EVAPORATION AND ITS SUPPRESSION BY CHEMICAL FILMS AT LAKE HEFNER,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
F. R. Crow, J. B. Allen, W. E. Fry, and A. L. Mitchell.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 889-895, 898, November-December 1969. 8 fig, 6 tab, 12 ref.

Descriptors: *Evaporation control, *Monomolecular films, *Hydrologic budget, *Energy budget, *Heat transfer, Mass transfer, Reservoir evaporation, Evaporation, Chemcontrol, Films, Hexadecanol, Octadecanol, Water conservation, Lakes, Instrumentation, Data collections, Wind velocity, Rates of application, Equations, Water temperature.
Identifiers: *Lake Hefner (Okla).

The purpose of the Lake Hefner experiments was to determine the relation between the energy budget and water budget methods of computing evaporation, determine heat and mass transfer coefficients for the lake, and investigate the effectiveness of monolayer-forming chemicals in reducing evaporation when applied continuously to a large lake by stationary application. Results were: (1) The evaporation studies showed that, if the water budget method were considered as standard, the energy budget method over-estimated lake evaporation. (2) Heat transfer coefficient K was computed as 1.82 cal per sq cm day mph deg C for the water budget method and 2.27 for the energy budget method. (3) Hexadecanol-octadecanol slurry was applied to the lake by a floating sprinkler system and an average film cover of 25% was achieved. It appears, however, that degree of evaporation reduction cannot be accurately measured using existing techniques. (Carr-Arizona)
W70-05300

PARK RANGE: ATMOSPHERIC WATER RESOURCES PROGRAM,
EG and G, Inc., Boulder, Colo., Environmental Services Operation.
J. O. Rhea, P. Willis, and L. G. Davis.
Available from the Clearinghouse as PB-188 596, $3.00 in paper copy, $0.65 in microfiche. Final rept., 30 Sep 69, 388 p. Bureau of Reclamation, Contract DI-14-06-D-5640.

Descriptors: *Artifical precipitation, *Cloud seeding, *Silver iodide, *Weather modification, Nucleation, Freezing, Mountains, Radiosondes, Snow, Winds, Air, Temperature, Clouds, Instrumentation, Feasibility.
Identifiers: Park Range (Colorado), Site selection.

The procedures and results of a five-year program of cloud seeding to increase orographic precipitation in the Park Range of Colorado are presented. Winter precipitation systems were seeded with silver iodide from ground generators and aircraft. Measurements in the seeding target area included: total snowfall, snowfall rate, freezing nuclei counts, type of snow crystals, and concentration of silver in snow, as well as radar and rawinsonde observations. As part of the investigation, diffusion tests were conducted to study the transport and dispersion of seeding agent, and a numerical model was developed to predict location and rate of snowfall as functions of observed wind, temperature, and stability.
W70-05317

3C. Use of Water of Impaired Quality

DESALTING SALINE GROUNDWATER FOR IRRIGATION PURPOSES - A CASE STUDY, BUCKEYE AREA, COLORADO RIVER BASIN, U.S.A.,
Bureau of Reclamation, Denver, Colo., Bureau of Reclamation, Nev.; and Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W70-05074

PHYSIOLOGICAL RESPONSE OF PLANTS TO SALINITY AND HUMIDITY,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
For primary bibliographic entry see Field 02I.
W70-05119

FEASIBILITY STUDY FOR GLENDALE - LOS ANGELES WATER RECLAMATION PLANT (CONDENSATION),
Engineering Science, Inc., Oakland, Calif.; and Koebig and Koebig, Inc., Los Angeles, Calif.
R. J. Theroux, and Robert L. White.
March 1969. 24 p, 4 fig.

Descriptors: *Water reuse, *Water pollution treatment, *Waste water, *Waste water treatment, *Water purification, *Beneficial use, *Reclaimed water, Industrial water, Planning.
Identifiers: *Los Angeles, *Glendale, *Water reclamation plant, *Hyperion Treatment Plant.

In March, 1968, the Cities of Glendale and Los Angeles entered into an agreement to conduct a study to determine the feasibility of constructing a joint water reclamation plant in the Glendale area. Engineering Services, Inc. and Koebig and Koebig, Inc. were retained to perform the engineering services. The comprehensive report concluded that it is necessary, and technically and economically feasible, to build and operate the plant through a joint-powers agreement. The proposed plant, designed for a capacity of 20 mgd in its initial stage, is to be built in 1970. Enlargement of the plant to 35 mgd is proposed for 1987. The final stage, to be completed in 1995, will bring the capacity up to 50 mgd. The plant will be constructed on 15 acres of Glendale property that is currently a community eyesore. Wastewater taken from trunk sewers will receive primary and secondary treatment. The reclaimed water will be sparkling clear and will be suitable for use in irrigation, industrial cooling, fire fighting, et cetera. Solid wastes will be removed and put back into the sewer, for processing at the Hyperion Wastewater Treatment Plant. The initial cost is estimated at $5.60 million with the corresponding cost per acre foot estimated between $29 and $32. This unit cost will decrease as the plant capacity is increased, so that by the year 2025 the unit costs of the reclaimed water should be about $19 per acre foot. Federal assistance under Public Law 660 appears promising. (Poertner-Chicago)
W70-05254

CONVENTIONAL AND ADVANCED WASTE TREATMENT,
Los Angeles County Sanitation District, Calif.
John D. Parkhurst.
Report No. 16, Univ. of Calif., Los Angeles, Calif. Water Resources Center, p. 16-28, Dec. 1969. 13 p, 2 tab, 1 map.

Descriptors: *Sewage treatment, *Tertiary treatment, *Water reuse, Costs, Demineralization, Anion exchange, Electrodialysis, Osmosis.

Waste water is generated within Los Angeles County at the rate of 700 million gallons per day. This waste water is an untapped supply of additional water. Water reclaimation and reuse has been continuing since 1949. Direct recharge of groundwater basins by spreading has been occurring as a natural adjunct of water treatment for many years. Such treatment of effluents meet health requirements. The sanitation districts' master plan is presented. Advanced waste treatment, or tertiary treatment, starts with secondary effluent and improves or tailors the quality of the water for some specific purpose. Two forms of secondary effluent removal are filtration and microstraining. Different methods of the removal of nutrients, such as phosphate, ammonia and nitrate, are given. Other aspects of secondary water treatment discussed are carbon absorption, demineralization, reverse osmosis, ion exchange, and electrodialysis. Data on water quality characteristics that result from demineralization processes are presented, as well as the costs of these processes. (See W70-05276). (Grossman-Rutgers)
W70-05277

TECHNICAL PROBLEMS CREATED BY REUSE,
California Univ., Berkeley. Sanitary Engineering Research Lab.
P. H. McGauhey.
Report No. 16, Univ. of Calif., Los Angeles, Calif. Water Resources Center, p 35-38, Dec. 1969. 4 p, 1 fig.

Descriptors: *Water reuse, *Separation techniques, Feasibility, Water quality.

Man must decide which tasks of water reuse he must undertake and which he leaves to nature. Man

must consider the technical problems created by reuse of water. Two alternate possibilities of solids management are presented in a diagram. Their particular technical problems are discussed. Systems problems are the technological problems of economically producing dry solids. Problems of type of use are presented with respect to agriculture and industrial use, and to municipal. Some problems are particular to the city. Finally, there is a problem of delivering reused waters. (See W70-05276). (Grossman-Rutgers)
W70-05278

DEPTH OF DRAINAGE IN IRRIGATED AREAS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 02G.
W70-05292

3D. Conservation in Domestic and Municipal Use

REPORT UPON ADEQUATE WATER SUPPLY FOR THE CHICAGO METROPOLITAN AREA--1969 TO 2000,
Alvord, Burdick and Howson, Chicago, Ill.
For primary bibliographic entry see Field 06D.
W70-05255

3E. Conservation in Industry

EFFECTS OF PUMPING FROM THE OHIO RIVER VALLEY ALLUVIUM BETWEEN CARROLLTON AND GHENT, KENTUCKY,
Geological Survey, Louisville, Ky.
For primary bibliographic entry see Field 04B.
W70-05506

3F. Conservation in Agriculture

EFFICIENCIES OF AN AUTOMATED SURFACE IRRIGATION SYSTEM WITH AND WITHOUT A RUNOFF RE-USE SYSTEM,
Nebraska Univ., Lincoln.
P. E. Fischbach, and B. R. Somerhalder.
Paper 69-716, Amer Soc Agr Eng 1969 Winter Meet, Chicago, Ill, Dec 1969. 12 p, 1 fig, 4 tab, 8 ref.

Descriptors: Irrigation, *Irrigation efficiency, *Water reuse, Runoff, Surface irrigation, *Uniformity coefficient, *Automatic control, *Remote control, Furrow irrigation, *Irrigation systems, Furrows, Soil moisture, Application methods, Nebraska, Experimental farms, Field tests.
Identifiers: *Water application rate, Irrigation advance, Reuse.

An automated surface irrigation system with a reuse feature was developed at the University of Nebraska field laboratory at Mead to determine the efficiencies of the system with and without reuse. Specific objectives were to determine: (1) the water application efficiencies, and (2) the water uniformity coefficient of an automated surface irrigation system. An automatic surface irrigation system with a reuse feature is an efficient method of applying irrigation water (91.9% water application efficiency) because the feature eliminates labor needed to use cutback furrow stream. Uniform water application can be accomplished (91.8% water uniformity coefficient) by designing the distribution system to apply a furrow stream 3 times the basic intake rate. The system should be designed not to exceed the maximum allowable furrow stream size--the furrow stream size selected should not cause serious erosion. Good correlation was found between the water uniformity coefficient measured by soil moisture sampling and the coefficient measured by using electrical resistance blocks. (USBR)
W70-05231

SEASONAL VARIATION OF HYDRAULIC PARAMETERS AND THEIR INFLUENCE UPON SURFACE IRRIGATION APPLICATION EFFICIENCY,
North Dakota State Univ., Fargo; and Rock Island Arsenal, Ill.
Charles L. Linderman, and Earl C. Stegman.
Paper 69-715, Amer Soc Agr Eng 1969 Winter Meet, Rock Island Arsenal, Ill.

Descriptors: Application methods, Infiltration, Soil moisture, Slopes, Rates of application, *Surface irrigation, *Irrigation efficiency, Field investigations, Irrigation, Farm units, Flow rates, Percolation, Runoff, Mannings equation, *Irrigation practices, Flow characteristics, Computer programming, *Seasonal, Flow resistance, Effects.
Identifiers: *Seasonal variations, Irrigation advance, Flow patterns, Infiltration rate, USBR research contracts.

An investigation was made to observe and characterize the seasonal hydraulic behavior of an irrigated farm unit. The study, conducted in 2 parts, included: (1) a field investigation to observe and characterize the seasonal hydraulic behavior of the irrigated unit, and (2) an analysis of the relative influence of several parameters on water application efficiency. By using a standard set of conditions, the relative influences of infiltration rate, retardance coefficient, soil moisture deficit, slope, and length of run on application efficiencies were studied. A computer program was used for calculating the advance and recession curves to estimate the volumes of water applied, stored, and lost to deep percolation or runoff. The analyses indicated that near-equal levels of application efficiency are attainable over a wide range of conditions. The relative influences of intake rate, border length, slope, roughness, and soil moisture deficit on application efficiency are demonstrated. (USBR)
W70-05235

ESTIMATING THE PRODUCTIVITY OF IRRIGATION WATER,
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 06B.
W70-05282

THE CLIMATOLOGY OF SOIL MOISTURE, EVAPORATION, AND NON-MOISTURE STRESS DAYS FOR CORN IN IOWA,
Environmental Science Services Administration, Rockville, Md.; and Iowa State Univ., Ames.
For primary bibliographic entry see Field 02D.
W70-05286

APPLICATION RATES AND RUNOFF IN CENTER-PIVOT SPRINKLER IRRIGATION,
Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.
D. C. Kincaid, D. F. Heermann, and E. G. Kruse.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 790-794, 797, November-December 1969. 6 p, 9 fig, 4 tab, 4 ref.

Descriptors: *Rates of application, *Application methods, *Sprinkler irrigation, *Runoff, *Soil types, Irrigation systems, Irrigation practices, Irrigation design, Irrigation efficiency, Slopes, Soil surfaces, Estimating, Data collections, Consumptive use, Soil water, Discharge (Water), Infiltration.
Identifiers: *Center-pivot sprinkler systems, *Soil intake rates, *Potential runoff, *Actual runoff.

Application rates and expected runoff in relation to different soil types were analyzed for the center-pivot sprinkler irrigation system. Potential runoff theory using modified experimental intake constants was applied to field situations. Results were compared with experimental estimates of actual runoff. Given a certain amount of potential runoff from a particular area, actual runoff depends on slope, roughness of soil surface, and position with respect to other runoff areas. Special attention should be given to soil surface conditions and intake rates when applying center-pivot systems to sloping lands. (Carr-Arizona)
W70-05288

EFFECT OF SOIL PROFILES ON MOVEMENT OF WATER ON SUBSURFACE IRRIGATION,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02G.
W70-05291

A HYDRODYNAMIC DETERMINATION OF CUTBACK STREAM SIZES OR IRRIGATION FURROWS,
Florida Univ., Gainsville. Dept. of Agricultural Engineering.
O. C. Wilke, and E. T. Smerdon.
American Society of Agricultural Engineers, Transactions, Vol 12, No 5, p 634-637, September-October 1969. 11 fig, 10 ref.

Descriptors: *Hydrodynamics, *Flow, *Furrows, *Furrow irrigation, *Irrigation engineering, Irrigation design, Channels, Streamflow, Runoff, Water management (Applied), Equations, Water loss, Infiltration, Mathematical models, Volume, Wetting, Application methods.
Identifiers: *Cutback, *Cutback sizes, Steady state.

In order to avoid runoff losses, the stream should be reduced after the wetting front nears or reaches the end of the furrow. Two methods of determining the required cutback size are volume balance analysis and numerical integration of the steady state equations of motion for shallow flow. These two methods were studied and graphic design relationships presented. Good field verification of the volume balance method was achieved, but more experimentation should be conducted. It would then be possible to design an automated cutback system which could apply water uniformly without runoff losses. (Carr-Arizona)
W70-05295

CROP RESPONSES TO RAINFALL MULTIPLIERS,
Nebraska Univ., Lincoln. Agricultural Experiment Station.
For primary bibliographic entry see Field 03B.
W70-05296

PLASTIC ORIFICE INSERTS FOR SUBSURFACE IRRIGATION,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering, and Office of Water Resources Research, Washington, D.C.
L. F. Whitney, and K. M. Lo.
American Society of Agricultural Engineers, Transactions, Vol 12, No 5, p 602-604, 607, September-October 1969. 4 p, 3 fig, 6 tab, 4 ref. WR-15, 1966 and Agway, Ind. 1967 and 1968.

Descriptors: *Subsurface irrigation, *Irrigation design, *Plastics, *Orifices, *Pipes, Flow rates, Equipment, Irrigation systems, Nozzles, Orifice flow, Pipe flow, Porous media, Application methods, Costs, Design, On-site tests, Tubes, Water distribution (Applied).

Economies in water use, plus advantages of liquid fertilizer and herbicide injection, have made subsurface irrigation the object of much study. Research has shown that the major problem of using plastic pipe for underground irrigation networks lies in developing a discharge orifice that resists clogging from internal water impurities and external soil particles. Three orifice designs were investigated: porous media, in-wall orifices protected by labyrinths, and plastic insert orifices. Results of the study were disappointing for porous media and in-wall orifice designs, the latter being completely unreliable. A plastic insert orifice was designed which featured uniform water distribution, easy installation, and low manufacturing cost. (Carr-Arizona)
W70-05297

DESIGN OF STABLE OPEN CHANNELS USING CRITICAL TRACTIVE-FORCE CONCEPT,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
L. Joe Glass.
American Society of Agricultural Engineers, Transactions, Vol 12, No 5, p 642-645, September-October 1969. 4 fig, 1 tab, 12 ref.

Descriptors: *Open channels, *Channels, *Irrigation canals, *Irrigation design, *Canal design, Design, Canals, Open channel flow, Cohesive soils, Depth-area curves, Soil properties, Tractive forces.
Identifiers: *Channel design, Design curves.

Empirical methods are generally employed in the design of open irrigation channels, since considerable engineering judgement is made necessary by variations in the properties of earth materials through which the channels are constructed. The theoretical approach to channel design has been studied but is not widely accepted. A theoretical procedure is presented here for designing stable open channels through cohesive soils. Design curves are developed and an example is included. Design curves may be obtained from the author. (Carr-Arizona)
W70-05298

MARGINAL VALUE OF IRRIGATION WATER AND A CASE STUDY OF TRANSFER IN SOUTHEASTERN WYOMING,
Wyoming Agricultural Experiment Station, Laramie.
J. N. Sorensen, and R. T. Clark.
Available from the Clearinghouse as PB-190 803, $3.00 in paper copy, $0.65 in microfiche. Agricultural Experiment Station, University of Wyoming Research Bulletin No. 511, January 1970. 42 p, 12 tab, 27 ref, 3 append. OWRR Project A-001-WYO.

Descriptors: *Marginal utility, *Water transfer, *Irrigation efficiency, *Return flow, Marginal benefits, Water rights, Marginal costs, Evaluation, Irrigation districts, Irrigation effieiency, Irrigation water.
Identifiers: *Marginal value, Wheatland Irrigation District, Ringsby Ranch.

The main objective of study was to provide economic information to aid decision-makers re: transfer of water rights between two types of agricultural users. Specific objectives were: (1) to present the legal environment for transfer; (2) to estimate marginal value of water to a farmer raising row crops; and (3) to estimate marginal value of water to a farmer or rancher who produces native hay. The area chosen for the analytical portion of the study was the Wheatland Irrigation District and its holdings, the Ringsby Ranch. The irrigation district is at an elevation ranging from about 4700 to 5000 feet. Ringsby Ranch elevation ranges from 7000 to 75000 feet above sea level. Data was obtained from personal interviews and from available secondary sources. Budgeting was used to develop input coefficients for use in linear programming models. Marginal value of water was estimated at various water levels for five different farm and ranch models. In analyzing transfer, it was assumed that one-half of purchased water would have to remain at place of origin to satisfy return flow requirements. Also it was assumed that there would be 50% delivery efficiency from Ringsby Ranch to the Wheatland farms. Findings indicate that transfer of water right would generally be economic where amount supplied to farms did not exceed 1.5 feet per acre. Marginal values of water ranged from nearly $20.00 per acre foot, on a farm having livestock, to less than $5.00 for a crop farm with no sugar beets. In this latter instance, transfer is found to be uneconomic, for transfer costs are estimated at $5.00 per acre foot. The main conclusion of the study is that water transfer between irrigators has some basis in terms of providing more returns from a given quantity of water at least on a yearly basis. More transfers would likely take place if the institutional arrangement unquestionably permitted transfer. Further study is needed to be more definite concerning permanent sale or transferof rights. It also can be concluded that before the marginal value of water for individual crops can be determined, physical studies with varying levels of water need to be conducted. (Rechard-University of Wyoming)
W70-05462

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

TEST OF NOURISHMENT OF THE SHORE BY OFFSHORE DEPOSITION OF SAND, LONG BRANCH, NEW JERSEY,
Army Coastal Engineering Research Center, Washington, D.C.
J. V. Hall, and W. J. Herron.
Available from the Clearinghouse as PB-101 026, $3.00 in paper copy, $0.65 in microfiche. Technical Memo., June 1950, 36 p., Rept. no. TM-17.

Descriptors: *Beaches, Erosion, *Sand, Deposition, Reaction, Construction, Hydrographic surveying, Tides, Ocean waves, Harbors, Piers, New Jersey.
Identifiers: Dredging, Long Branch (N J), Beach erosion.

The paper presents results of a study to test the feasibility of nourishing eroded shores with dredge spoil.
W70-05111

UNSTEADY FLOW OF DILUTE AQUEOUS POLYMER SOLUTIONS IN PIPE NETWORKS-A METHOD TO IMPROVE WATER DISTRIBUTION,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
For primary bibliographic entry see Field 08A.
W70-05120

FLOOD PLAIN INFORMATION - CANYON CREEK AT JOHN DAY AND CANYON CITY, OREGON.
Corps of Engineers, Walla Walla, Wash.

Corps Engineers Flood Plain Report, May 1969. 28 p, 5 fig, 7 plate, 1 tab.

Descriptors: *Floods, *Flood damage, *Oregon, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: John Day (Oreg), Canyon City (Oreg), Standard project flood, Intermediate regional flood.

Flooding of Canyon Creek, John Day and Canyon City, Oregon is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05171

FLOOD PLAIN INFORMATION, CUYAHOGA RIVER, CUYAHOGA AND SUMMIT COUNTIES, OHIO.
Corps of Engineers, Buffalo, N.Y.

Corps Engineers Flood Plain Report, September 1969. 47 p, 22 fig, 13 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Ohio, *Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Cuyahoga River (Ohio), Standard project flood, Intermediate regional flood.

Flooding of the Cuyahoga River, Ohio is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05172

AN EVALUATION OF RADAR IMAGERY AS A TOOL FOR DRAINAGE BASIN ANALYSIS,
Kansas Univ., Lawrence. Dept. of Geography.
For primary bibliographic entry see Field 07B.
W70-05180

FLOOD PREVENTION AND DAMAGE REDUCTION.
Nebraska Soil and Water Conservation Commission, Lincoln.
For primary bibliographic entry see Field 06F.
W70-05187

HYDRAULICS OF STRATIFIED FLOW - SECOND PROGRESS REPORT SELECTIVE WITHDRAWAL FROM RESERVOIRS,
Bureau of Reclamation, Denver, Colo.
D. L. King.
Bur Reclam Rep Hyd-595, Sept 1969. 54 p, 17 fig, 4 tab, 24 ref, append.

Descriptors: Research and development, Reservoirs, Reviews, *Hydraulic models, Density currents, Hydraulics, Water quality, Temperature, Froude number, *Stratification, Velocity distribution, *Thermal stratification, Theory, Bibliographies, Design criteria, *Stratified flow.
Identifiers: *Multilevel outlets, *Selective level releases, Progress reports.

Selective outlet works for reservoirs provide an important control for maintaining water quality in the downstream river. The use of multilevel outlets is growing, but design guidelines are seriously lacking. A study of previous theoretical and experimental work in selective withdrawal from reservoirs shows that a basis exists for development of practical design and operating criteria. Beginning with the theory for selective withdrawal from a continuously stratified fluid, a method is developed for the more general density profile. The method is verified with experimental data. Limitations of the method and the need for further experimental verification with model and prototype data are discussed. (USBR)
W70-05251

FACTORS AFFECTING GROWTH OF ROOTED AQUATIC PLANTS IN A RESERVOIR,
Tennessee Valley Authority, Muscle Shoals, Ala. Environmental Biology Branch; and Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-05260

SUMMARY OF LITERATURE ON AQUATIC WEED CONTROL,
Toronto Univ. (Ontario).
For primary bibliographic entry see Field 05C.
W70-05263

LEVEE AND DRAINAGE DISTRICTS (CERTAIN INTERNAL IMPROVEMENTS).

Iowa Code Ann secs 455.148-455.150 (1949).

Descriptors: *Drainage districts, *Levees, *Iowa, *Obstruction to flow, Tile drains, Root systems, Shrubs, Trees, Right-of-way, Legislation, Administration, Ditches, Laterals, Legal aspects, Condemnation, Outlets, Assessments, Costs.

The Board of Supervisors of a drainage district shall have any obstructions, which interfere with the flow of water, removed from the ditches of the district. Any tile drain so obstructed may be relaid. Costs of all such work are to be paid from drainage funds of the district. It may become necessary to destroy trees or hedges outside the right-of-way of any ditch in order to prevent obstruction by the roots thereof. If the Board and the owners of such trees or hedges cannot agree on the damage for the destruction thereof, the Board may move to acquire the right to destroy the trees or hedges. This should be done in the same manner in which the right-of-way was acquired. The owner of any premises assessed for costs of a drainage system shall have the right to use the same as an outlet for lateral drains from his premises. The Board shall promulgate specifications covering the manner of connection of such lateral drains and their maintainance. The owner shall comply with these specifications. (Cuevas-Florida)
W70-05303

RURAL WATER DISTRIBUTION SYSTEMS: AN ANALYSIS OF CREATING A LOCAL SYSTEM,
For primary bibliographic entry see Field 06E.
W70-05341

ILLINOIS DRAINAGE CODE (SUBDISTRICTS).
Ill Ann Stat, ch 42, secs 7-1 thru 7-12, (Smith-Hurd), as amended, (Supp 1970).

Descriptors: *Illinois, *Drainage districts, *Drainage systems, *Drainage programs, Administrative agencies, Soil conservation, Civil engineering, Construction, Surveys, Assessments, Cost allocation, Drains, Outlets, Project planning, Administration, Decision making, Legal aspects.
Identifiers: *Subdistricts.

Drainage districts may be divided into subdistricts for the purpose of providing more complete drainage or protection of lands within the proposed subdistrict. Administrative procedure is provided for the establishment of subdistricts by the drainage district commissioners. Any subdistrict so organized shall be a body politic and shall have all the powers of a main district. The commissioners for the main district shall also serve as commissioners for any subdistrict. Minor subdistricts may be organized within subdistricts following this same procedure. (Dearing-Florida)
W70-05350

LEVEE DISTRICTS (ORGANIZED BY CIRCUIT COURT).

Mo Ann Stat secs 245.030 thru 245.085 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Administrative agencies, *Jurisdiction, *Levees, Land tenure, Land, Legislation, Taxes, Benefits, Assessments, Land reclamation, Administration, Leadership, Legal aspects, Political aspects, Governments, State governments, Local governments, Financing.
Identifiers: *Levee districts.

Upon petition to the circuit court, any two or more adjacent levee districts may consolidate. The Board of Supervisors of each district shall file such petition, and any landowner in either of the districts may file objections. New districts shall be subject to all the rights and obligations outlined in this chapter. The corporate life of a district may be extended in order to complete works and perform obligations. Levee districts may reorganize pursuant to this chapter, and all reorganized districts shall be entitled to the benefits herein provided. This chapter also provides for: hearing procedures, election of boards of supervisors, annual reports, annual meetings, and control of district records and money. (Duss-Florida)
W70-05360

SANCO SALES, INC., V MASSACHUSETTS BAY TRANSPORTATION AUTHORITY (LIABILITY FOR DIVERSION OF RAIN WATER).

252 N E 2d 214-215 (Mass 1969).

Descriptors: *Massachusetts, *Cloudbursts, *Diversion structures, *Flood damage, Judicial decisions, Surface runoff, Floods, Overland flow, Precipitation excess, Rain water, Repulsion (Legal aspects), Storm runoff, Surface waters, Surface drainage, Barriers, Check structures, Retaining walls, Obstruction to flow, Flood protection, Flash floods, Rain, Water injury, Alteration of flow, Relative rights, Legal aspects.

To prevent the inundation of an underground streetcar station during a series of long rainstorms, defendant transportation authority erected two farriers across its tracks between two retaining walls. Plaintiff suffered water damage to his personal property when surface water produced by the rains flowed along the streetcar property and into an area between a retaining wall and plaintiff's building. Plaintiff sued in tort, and the trial judge directed a verdict for defendant. The appellate court found no error, and held that the barriers were erected by defendant on its property in exercise of its right to divert surface waters from the property. Defendant has this right irrespective of the possibility of harm to nearby property, absent a showing of negligence or trespass. (Douberley-Florida)
W70-05367

FORMATION AND PURPOSES OF DRAINAGE DISTRICTS.
Mo Ann Stat secs 243.010 thru 243.070 (1952).

Descriptors: *Missouri, *Drainage districts, *Ditches, *Drains, Bank protection, Levees, Land tenure, Public health, Construction, Streams, Lakes, Banks, Erosion, Navigable waters, Federal government, Financing, Planning, Costs, Legislation, Water levels, Legal aspects, Project planning, Projects, Watercourses (Legal).

As used in this chapter the word ditch shall include drains, watercourses, bank protections, current controls and levees. In the interest of public health and welfare and to effect necessary construction in order to protect land or other property the county court has authority to organize and establish drainage districts. Such improvements may include branch ditches, the lowering of lake levels, and protection of stream banks from erosion. When work is done on navigable streams, consent shall first be obtained from the federal government. Before the establishment of any drainage district, at least one affected landowner shall file a petition stating its necessity, proposed boundaries, and the names of landowners within the proposed districts' boundaries. The county court shall appoint counsel to assist in the establishment of the district. The court shall appoint an engineer to determine the necessity for the improvements and to indicate their dimensions, location and probable costs. The engineer shall also determine if any lands adjacent to the district will be benefited. Hearings on the engineers' determination shall be held and interested parties may object to such improvements. (Duss-Florida)
W70-05418

PROCEDURE FOR DISSOLUTION OF LEVEE DISTRICTS.
Mo Ann Stat secs 245.270 thru 245.280 (1959).

Descriptors: *Missouri, *Levees, *Flood control, Legal aspects, Legislation, Taxes, Organizations, Administrative agencies, Cost allocation, Financing, Drainage systems, Management, Jurisdiction, Supervisory control (Power).

Circuit courts may dissolve levee districts when the owners of a majority of the land acreage petition for dissolution. Before dissolving a district, the circuit court must ascertain and determine that all debts, warrants, and obligations of the district have been paid. If a district is unable to meet financial obligations from existing assets, the court will direct the board of supervisors of the levee district to levy and collect a uniform tax to satisfy these obligations before dissolution will be permitted. The repeal of existing laws does not affect existing rights of levee districts. (Casey-Florida)
W70-05436

POWERS OF LEVEE DISTRICTS.
Mo Ann Stat secs 245.225 thru 245.265 (1959).

Descriptors: *Missouri, *Levees, *Costs, *Administration, Legal aspects, Administrative agencies, Flood protection, Bodies of water, Legislation, Taxes, Tax rate, Assessments, State governments, Inspection, Control, On-site investigations, Regulation, Flood control, Supervisory control (Power).
Identifiers: Penalties (Criminal).

Any levee district may institute an action against the record owner of real property to enforce collection of delinquent assessments. Unpaid assessments become a lien on the property. Authority is granted to the board of supervisors of each levee district to issue bonds, levy taxes, and issue warrants for payment of maturing bonds. Funds from the sale of bonds may only be used for paying the cost of the levee works, improvements, expenses, fees, and district salaries. The board of supervisors may appoint inspectors for guarding and inspecting levees. The duties and powers of these inspectors include making periodic reports of the condition of levee works and enlisting the aid of district residents to protect levees during emergencies. Penalties for violation of these provisions are provided. (Casey-Florida)
W70-05444

BASE-FLOW-RECESSION CURVES,
For primary bibliographic entry see Field 02E.
W70-05507

FLOOD PLAIN INFORMATION, JORDAN RIVER COMPLEX, SALT LAKE CITY, UTAH.
Corps of Engineers, Sacramento, Calif.

Report prepared for Utah Div of Water Resources and Salt Lake City and County. Corps Engineers Flood Plain Report, October 1969. 21 fig, 28 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *Utah, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Salt Lake City (Utah), Jordan River (Utah), Standard project flood, Intermediate regional flood.

Flooding of the Jordan River, Salt Lake City, Utah is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05518

FLOOD PLAIN INFORMATION, POESTA CREEK AND SALT CREEK, BEEVILLE, TEXAS.
Corps of Engineers, Galveston, Tex.

Corps Engineers Flood Plain Report, April 1969. 35 p, 7 fig, 16 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Beeville (Tex), Standard project flood, Intermediate regional flood.

Flooding of Beeville, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05519

EXPERIMENTS FOR THE VERIFICATION OF THE PASSAGE THEORY,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02E.
W70-05532

4B. Groundwater Management

REASONABLE STATE REGULATION OF THE INTERSTATE TRANSFER OF PERCOLATING WATER,
Cornell Univ., Ithaca, N.Y. School of Law.
For primary bibliographic entry see Field 06E.
W70-05334

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE,
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 259-306, Oct 1968. 48 p, 4 fig.

Descriptors: *Groundwater, *Federal reclamation law, *Water rights, *Water allocation (Policy), Legislation, Federal government, Prior appropriation, Beneficial use, Federal project policy, Preferences (Water rights), Withdrawal, Water utilization, Groundwater basins, Surface-groundwater relationships, Water sources, Irrigation, Water storage, Supplemental irrigation, Water contracts, Groundwater recharge, Water policy, Competing uses, Project purposes, Federal-state water rights conflicts, Groundwater movement.
Identifiers: *Project groundwater.

Projects under the Federal Reclamation Act have created groundwater in the form of underground basins or return flow into other basins or watercourses. Since legal rights to project groundwater were not determined in the Act, the law has been in a state of flux over allocating those rights. A number of bases for the exercise of rights to project groundwater by the federal government or by the project itself are outlined. Most of these are based on the beneficial use concepts of the prior appropriation doctrine. Specific problems are outlined that are prevalent with relation to use of project groundwater for lands covered by the Act within the project area, lands within the project area but not covered by the Act, and land wholly outside the project area. Solutions derived from existing law are suggested for each category. The most comprehensive solution lies in an amendment to the Act. The author details a proposal which purports to cover the major problem areas discussed. (See also W70-05336 thru W70-05340). (Douberley-Florida)
W70-05335

PROJECT GROUNDWATER PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGAL RIGHTS TO GROUNDWATER),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 259-271, Oct 1968. 12 p.

Descriptors: *Groundwater, *Federal reclamation law, *Water rights, *Prior appropriation, Federal government, Legislation, Reclamation, Federal project policy, Irrigated land, Irrigation effects, Irrigation programs, Land development, Water utilization, Water allocation (Policy), Subsurface waters, Percolating water, Underflow, Groundwater basins, Surface-groundwater relationships, Water sources, Watersheds (Basins), Preferences (Water rights), Federal jurisdiction.
Identifiers: *Project groundwater.

The purpose of the Reclamation Act was to provide irrigation water to 160-acre farms, to promote western family-sized farms, and to fragment the holdings of large ranchers. Many problems still exist with relation to groundwater created by the storage, transportation and irrigation aspects of the project. Project groundwater is that which either percolates to underground water basins or constitutes return flow to a surface watercourse or groundwater basin further down the watershed. Definite legal authority allocating rights of control or use of project groundwater is lacking, both in the Act and in state statutes. There are existing bases for the exercise of rights by the federal government or by the reclamation project: states may recognize groundwater as water belonging to the project; the Act preserves a project's right to water it subjects to a beneficial use; contracts with water users reserve rights in the federal government; and the United States Supreme Court has upheld the federal government's rights to use groundwater seepage. The Act adopts the law of prior appropriation and beneficial use to govern rights of use in project water. The problem is to balance the furtherance of reclamation against maximation of beneficial use of the resource. (See W70-05335). (Douberley-Florida)
W70-05336

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-EXCESS LANDOWNER PROBLEM),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 271-280, Oct 1968. 11 p.

Descriptors: *Groundwater, *Federal reclamation law, *Water contracts, *Beneficial use, Water requirements, Supplemental irrigation, Irrigation water, Surface water, Subsurface irrigation, Prior appropriation, Appropriation, Water rights, Water storage, Usable storage, Withdrawal, Water utilization, Cost-benefit theory, Cost repayment, Project planning, Water utilization, Water allocation (Policy), Irrigation permits, Groundwater recharge.
Identifiers: *Project groundwater, Irrigation subsidies.

The landowner who does not own land in excess of 160 acreas already receives irrigation water at a price below project costs. This subsidy is increased if he is allowed free use of project groundwater to substitute for surface water. The landowner might have a right to the water as a successor to the project's appropriative rights acquired by it from the state. On the other hand, it might be that he receives only the right to water, rather than an unlimited right of use in the water. The soundest analysis is that the landowner's water right is a contractural right, which reserves rights of use in project groundwater in the government or the project. Under the contractural provisions, the landowner should be precluded from withdrawing groundwater presently subjected to beneficial use by the project. The concept of beneficial use could be expanded to include water storage when it is a necessary part of a large scheme of beneficial use or when the development of a groundwater supply will contribute to the project. Alternative solutions include short-term contracts with landowners authorizing withdrawal of water for an appropriate price. (See W70-05335). (Douberley-Florida)
W70-05337

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE EXCESS LANDOWNER PROBLEM),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 280-290, Oct 1968. 10 p.

Descriptors: *Water contracts, *Groundwater, *Federal reclamation law, *Water rights, Prior appropriation, Supplemental irrigation, Subsurface irrigation, Irrigation permits, Water permits, Withdrawal, Beneficial use, Irrigation water, Water allocation (Policy), Infiltration, Groundwater recharge, Natural recharge, Artificial recharge, Federal project policy, Project planning, Water policy, Water sources.
Identifiers: *Project groundwater.

The Reclamation Act, by providing an irrigation subsidy for the excess lands if a contract for sale were executed induced the landowner having more than 160 acres to split his holdings. The inducement is subverted if he is able to irrigate the excess lands with project groundwater. The clause in the contract reserving rights in the government to groundwater might be construed as extending to excess lands as well, but this provision should be made clear in future contracts. Withdrawals may also be enjoined if in derogation of the project's appropriative rights, but a beneficial use must be exercised by the project at all times. An expanded concept of beneficial use would be helpful. It should be assumed that all groundwater within the project area is project water, subject to positive proof by a landowner of co-mingling with other groundwater sources. An alternative would be to expand the term water, as used in the Act to include groundwater. Future projects might require contracts relating to water use from all or most of the landowners before the project is instituted. The Act might be amended to allow for supplemental contracts for the use of excess groundwater. (See W70-05335). (Douberley-Florida)
W70-05338

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-PROJECT LANDOWNER PROBLEM),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 290-300, Oct 1968. 10 p.

Descriptors: *Groundwater, *Federal reclamation law, *Water rights, *Withdrawal, Appropriation, Prior appropriation, Consumptive use, Beneficial use, Water contracts, Water utilization, Project benefits, Groundwater basins, Hydrology, Legislation, Underflow, Competing uses, Preferences (Water rights), Groundwater movement, Groundwater barriers, Obstruction to flow, Prescriptive rights, Influent streams, Project purposes.
Identifiers: *Project groundwater, Warren Act.

The landowner who is not a part of the project but who withdraws project groundwater obtains undeserved benefits and causes potential project restriction as a competing appropriator. He is precluded from withdrawing water which is continually subjected to present consumptive benefi-

cial use by the project. Beneficial use may be exercised by expanding the Warren Act or by amending the Reclamation Act to allow contracts for delivery of project water to non-project landowners, pending full utilization of water for irrigation of project lands. As to groundwater basins that extend beyond the project area, it remains within the project's appropriation so long as it is put to beneficial use. Otherwise, a landowner outside the project area might obtain appropriation rights prior to the project. Solutions include drawing project boundaries with reference to underground basins or precluding the establishment of adverse rights through legislation. As to return flow water outside project boundaries, that water may be considered abandoned by the project, but the right to withdraw and use the water for project purposes at a later date is retained. The non-project landowner has only a defeasible interest in such waters. (See W70-05335). (Douberley-Florida)
W70-05339

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGISLATIVE PROPOSALS),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 301-306, Oct 1968. 6 p, 4 fig.

Descriptors: *Groundwater, *Federal reclamation law, *Preferences (Water rights), Federal project policy, State governments, Federal government, Legislation, Federal-state water rights conflicts, Prior appropriation, Water contracts, Cost-benefit theory, Project purposes, Water utilization, Water permits, Irrigation permits.
Identifiers: *Project groundwater.

A comprehensive solution to project groundwater problems may well come from federal legislation amendatory to the Reclamation Act. The author's proposal provides that state laws shall be inapplicable to the priority and use of water within reclamation projects. Affected state legislatures are to enact a uniform law which recognizes all project groundwater as being exclusively subject to control by the project. Provisions are made for delivery of water to tracts in excess of 160 acres on a short-term contractural basis, with charges varying with the availability of surface and groundwaters. First priority to the use of project waters is to be for delivery and use upon tracts of 160 acres or less, pursuant to the purposes of the original Act. (See W70-05335). (Douberley-Florida)
W70-05340

WELL DRILLERS: REGULATION.

MD Ann Code, Art 96A:80-88 (Supp 1969).

Descriptors: *Maryland, *Well regulation, *Permits, *Water wells, Legislation, Regulation, Administration, Administrative agencies, State governments, Local governments, Rates, Legal aspects, Well permits, Drilling, Core drilling, Drilling equipment.
Identifiers: *Penalties (Civil).

Any person doing business as a well driller in Maryland must comply with this act. Well, well driller, and the business of well drilling are defined. Only licenses as issued under this subtitle shall authorize any person to engage in business as a well driller. Local governments may make and enforce ordinances with respect to the use of water or wells but may not require special authorization to be a well driller. The Maryland State Board of Well Drillers is created to enforce the provisions of this subtitle and to make rules not inconsistent with those herein. The Board shall issue well-driller licenses to qualified applications and shall collect an annual fee for such license privilege. Upon hearing and determination of guilt the Board may suspend or revoke a license for fraud, deceit or gross negligence in license obtainment, or conduct of business. Upon reevaluation such license may be reissued. The Board may enter into reciprocity agreements with other states to allow well drilling without further fee or examination. Penalties for engaging in business as a well driller without a license are provided. (Barnett-Florida)
W70-05351

REUTILIZATION OF WASTEWATER RECYCLED THROUGH GROUNDWATER, VOLUME 1 AND 2.
Eastern Municipal Water District, Hemet, Calif.
For primary bibliographic entry see Field 05D.
W70-05466

EFFECTS OF PUMPING FROM THE OHIO RIVER VALLEY ALLUVIUM BETWEEN CARROLLTON AND GHENT, KENTUCKY,
Geological Survey, Louisville, Ky.
D. V. Whitesides, and Paul D. Ryder.
Kentucky Geological Survey, Series 10, Information Circular 18, 1969. 20 p, 9 fig, 19 ref.

Descriptors: *Induced infiltration, *Aquifers, *Water level fluctuations, *Kentucky, Hydrogeology, Alluvium, Surface-groundwater relationships, Water management (Applied), Withdrawal, Water levels, Water wells, Water yield, Ohio River.
Identifiers: Carrollton (Ky), Ghent (Ky).

Recent industrial expansion coupled with increased groundwater withdrawals has caused water levels in the heavily pumped areas between Carrollton and Ghent, Ky., to decline as much as 30 feet in the past year and a half. Water levels in areas remote from centers of heavy pumping are about normal and fluctuate seasonally. Total amount of groundwater available for withdrawal in the Carrollton-Ghent area is about 10.5 billion gallons. Total pumpage of about 14 million gallons per day from closely spaced industrial wells has resulted in excessive drawdown in localized pumping areas. Induced infiltration from the Ohio River has sustained yields of several million gallons per day in similar areas. Accurate knowledge of induced infiltration characteristics at each heavily pumped area is lacking. This knowledge and proper location of wells near and parallel to the river to maximize river infiltration are critical to the problem of insuring an adequate water supply without excessive drawndown in this area. (Knapp-USGS)
W70-05506

IRRIGATION AND MUNICIPAL WELLS IN THE SAN LUIS VALLEY, COLORADO,
Geological Survey, Denver, Colo.
Philip A. Emery, John M. Dumeyer, and Harold J. McIntyre, Jr.
Geological Survey Open-file Report, November 1969. 7 p, 2 fig, 1 plate, 1 tab, 3 ref.

Descriptors: *Water resources, *Groundwater, *Colorado, *Irrigation water, Water wells, Aquifers, Water supply, Water levels, Water yield, Artesian wells, Water table.
Identifiers: *San Luis Valley (Colo).

The San Luis Valley, Colorado, extend about 100 miles southward from Poncha Pass to a point about 16 miles south of the Colorado-New Mexico State line. The valley has little topographic relief. The altitude of the Colorado part of the valley is about 7,700 feet above sea level. The agricultural economy of the valley depends on irrigation. When the surface-water supply is deficient, groundwater is used as a supplemental supply. The aquifers of the San Luis Valley contain at least 2 billion acre-feet of water. The water occurs in unconfined and confined aquifers. A summary of the thickness, physical character, and water-supply characteristics of the aquifers is given. Records of wells were obtained from the Colorado State Engineer's office, field-checked for accuracy of location, and tabulated. In January 1969, there were 2,883 large-capacity wells in the San Luis Valley. Of this total, 2,228 tap the unconfined aquifer. In addition to the large-capacity wells, there are more than 7,000 small-capacity flowing wells in the valley. (Knapp-USGS)
W70-05508

GEOHYDROLOGY AND GROUNDWATER POTENTIAL OF ST. JOSEPH COUNTY, INDIANA,
Geological Survey, Indianapolis, Ind.
For primary bibliographic entry see Field 02F.
W70-05509

4C. Effects on Water of Man's Non-Water Activities

WILLAMETTE RIVER AT LAMBERT BEND, OREGON- FLOODFLOW CHARACTERISTICS OF THE PROPOSED GREENACRES ROAD CROSSING,
Geological Survey, Portland, Oreg.
For primary bibliographic entry see Field 02E.
W70-05072

ANALOG COMPUTER SIMULATION OF THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
W70-05118

GROUNDWATER FLOW SYSTEMS AND RELATED HIGHWAY PAVEMENT FAILURE IN COLD MOUNTAIN VALLEYS,
Idaho Univ., Moscow.
Roy E. Williams.
Journal of Hydrology, Vol 6, No 2, p 183-193, April 1968. 11 p, 4 fig, 9 ref.

Descriptors: *Road construction, *Paving, *Drainage systems, *Cold regions, *Groundwater movement, *Ice, Discharge (Water), Percolation, Capillary fringe, Drainage engineering, Pore pressure, Saturation.
Identifiers: *Ice lenses, Groundwater sink, Gravity flow.

Seepage from groundwater systems in cold-region valleys is responsible for the formation and growth of ice lenses beneath highways. Mountains form recharge areas and valley floors become places of discharge and near-surface lateral flow. Ideal conditions for growth of ice lenses are found in frost-susceptible soil, a water source, and the absence of high negative pore-water pressures. Ice lenses grow unusually thick in groundwater discharge areas where the consistent source of water is under positive head. In such areas, highways with impermeable clay or asphalt shoulders may be undesirable. Here roadbeds need draintile networks and/or permeable fill material which would eliminate excess pore-water pressure, lower the capillary fringe, and insure unsaturated conditions, thus limiting growth of ice lenses. Alternatives would include highway location along the valley flank away from discharge areas. (Lang-USGS)
W70-05184

HYDRAULIC PROPERTIES OF STREETS.
Los Angeles Dept. of Public Works, Calif.
For primary bibliographic entry see Field 08B.
W70-05257

NOVAK V TOWN OF AGENDA (LIABILITY FOR WATER DAMAGE WHEN HIGHWAY IS IMPROVED).

172 NW2d 38-42 (Wis 1969).

Descriptors: *Wisconsin, *Road construction, *Surface runoff, *Flood damage, Judicial deci-

sions, Highways, Roadbanks, Road design, Roads, Culverts, Landfills, Overland flow, Storm runoff, Surface waters, Surface drainage, Water injury, Natural flow, Runoff, Condemnation, Damages, Drainage, Drainage patterns, Drainage water, Excess water (Soils), Riddance (Legal aspects).
Identifiers: Inverse condemnation.

Defendant municipality, in resurfacing a highway, raised by landfill a portion of the road adjoining plaintiff's farm and installed a culvert to allow water to flow underneath the road. Plaintiff alleged that the fill and culvert increased the flow of surface funoff onto her land, requiring the digging of a drainage ditch and subjecting her barnyard to possible flooding. Plaintiff instituted an inverse condemnation action for damages. Inverse condemnation allows compensation for a landowner whose land has been taken by a body with the power of condemnation but which failed to exercise it. After hearing disputed testimony, the trial court found that the fill area was far enough from the culvert that the quantity of water channeled onto plaintiff's land was not affected. It further found that the culvert did not change the flow lines of the natural drainage in the area, since excess water had been running over the highway prior to the installation of the culvert. Since plaintiff's land was not wrongfully occupied by the municipality, the action was dismissed. The appellate court affirmed. (Douberley-Florida)
W70-05365

TECHNICAL SERVICES FOR URBAN FLOOD-PLAIN PROPERTY MANAGERS: PROBLEM FORMULATION AND STUDY OF PROPERTY MANAGER RECEPTIVITY,
Northwestern Univ., Evanston, Ill.
Kenneth J. Cypra.
A doctoral dissertation for a Ph. D. in civil engineering, Evanston, Illinois, 1970, p 153, 19 fig, 21 tab, 35 ref.

Descriptors: *Flood plains, *Floodproofing, *Maps, *Methodology, *Non-structural alternatives, Urbanization, Formulation.
Identifiers: *Flood plain management, *Flood plain managers, *Property managers, *Homeowners, *Structural alternatives, *Technical services, *Flood history, *Receptivity, Conclusions, Recommendations.

The author discusses technical services for urban flood plain managers in terms of problem formulation and property manager receptivity. In Chapter I, the problems associated with technical services design are discussed. In Chapter II, property manager receptivity is analyzed in terms of problem scope, definition and formulation. The experimental design is outlined in Chapter III, and Chapter IV deals with the analysis and study results. Conclusions and recommendations are given in Chapter V. The report is significant because it deals with the individual homeowner's willingness to purchase technical flood plain management services designed for his specific needs (non-structural alternatives) rather than services oriented toward a community or regional scale (structural alternatives), e.g., channel improvements, structural abatement. (Richmond-Chicago)
W70-05443

BASIC DATA FOR URBAN HYDROLOGY STUDY, DALLAS, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05500

4D. Watershed Protection

LAND-USE REGULATIONS.

Va Code Ann secs 21-66 thru 21-79 (1960).

Descriptors: *Virginia, *Land use, *Soil conservation, *Natural resources, Legislation, Legal aspects, Regulation, Boundaries (Property), Construction, Outlets, Dams, Dikes, Ponds, Ditches, Structures, Check structures, Reforestation, Drainage, Terracing, Agricultural engineering.
Identifiers: *Forestation, Referendums.

Soil conservation district supervisors are authorized to formulate regulations governing the use of lands within their district. The purpose of such regulations will be the conservation of soil resources and the prevention and control of soil erosion. This section deals with the manner in which proposed regulations are transformed into ordinances by way of referendums. Provision is made for referendums, hearings on proposed regulations, who may vote, the percentage of votes required for approval, and amendment or repeal of regulations. Supervisors may propose regulations which include: (1) provisions requiring engineering operations including the construction of terraces, terrace outlets, check dams, dikes, ponds, ditches and other necessary structures; (2) provisions requiring particular methods of cultivation including the planting of lands to water-conserving and erosion-preventing plants, grasses and trees; forestation and reforestation; (3) specifications of cropping programs and tillage practices; (4) provisions prohibiting cultivation in given areas if this is the only way to control erosion; and (5) provisions for such other means, measures, operations and programs as may assist conservation of soil resources and prevent or control soil erosion. (Keith-Florida)
W70-05445

THE DEVELOPMENT OF DISCONTINUOUS GULLIES IN A PUMICE CATCHMENT,
Sydney Univ. (Australia). Dept. of Geography.
R. J. Blong.
American Journal of Science, Vol 268, No 4, p 369-383, April 1970. 15 p, 2 fig, 4 plate, 6 ref.

Descriptors: *Gully erosion, *Pumice, *Geomorphology, Soil erosion, Climatology, Channel erosion, Infiltration, Groundwater movement, Surface-groundwater relationships.
Identifiers: *New Zealand.

Observations of recent changes in the morphology of pumice gullies on the humid temperate Volcanic Plateau, North Island, New Zealand, provide the basis for a generalized model of sequential gully development. Once gullying ceases, the sidewalls retreat under the influence of blockfall and talus formation to angles of 25 to 35 degrees. Gully wall exposures reveal that similar events have occurred several times since the deposition of Taupo Pumice in 130 A.D. While the influence of land development on modern gully growth may sometimes be important, the effects of climatic events must not be overlooked. The major features of the present gullies and of those formed prior to European intervention are similar. (Knapp-USGS)
W70-05471

COMPILATION OF HYDROLOGIC DATA, MUKEWATER CREEK, COLORADO RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05501

COMPILATION OF HYDROLOGIC DATA, PIN OAK CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05502

COMPILATION OF HYDROLOGIC DATA, NORTH CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05503

COMPILATION OF HYDROLOGIC DATA, GREEN CREEK, BRAZOS RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05504

COMPILATION OF HYDROLOGIC DATA, HONEY CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05505

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

PERSISTENT PESTICIDES IN THE ENVIRONMENT,
Rothamsted Experimental Station, Harpenden (England); and Minnesota Univ., St. Paul. Inst. of Agriculture.
For primary bibliographic entry see Field 05C.
W70-05057

CHANGING PRACTICES IN AGRICULTURE AND THEIR EFFECT ON THE ENVIRONMENT,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering; and California Univ., Davis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05C.
W70-05058

PHYSICAL AND ENGINEERING ASPECTS OF THERMAL POLLUTION,
Vanderbilt Univ., Nashville, Tenn.; and New York State Dept. of Health, Albany.
For primary bibliographic entry see Field 05C.
W70-05059

OBJECTIVE ANALYSIS OF THE STRONTIUM-90 CONCENTRATION FIELD IN THE ATLANTIC OCEAN,
Akademiya Nauk URSR, Kiev. Morskyi Hidrofizychnyi Instytut.
V. I. Belyayev, I. F. Doronin, A. I. Yermolenko, T. M. Ivanova, and B. A. Nelepo.
Transl from Izvestiya Akad Nauk SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 8, 1969, pp 860-867. Atmospheric and Oceanic Physics, Academy of Sciences, USSR, Vol 5, No 8, p 489-493, August 1969. 5 p, 4 fig, 2 tab, 10 ref.

Descriptors: *Radioisotopes, *Strontium radioisotopes, *Sea water, *Atlantic Ocean, Mapping, Trace elements, Fallout, Radiochemical analysis.
Identifiers: USSR.

Using the method of objective analysis, a map of the strontium-90 concentration at the surface of the Atlantic Ocean is plotted on the basis of observation data obtained by the research vessel 'Mikhail Lomonosov' for the period 1962-1964. (Knapp-USGS)
W70-05069

A VOLUMETRIC RESPIROMETER FOR STUDIES OF AERIAL AND AQUATIC OXYGEN CONSUMPTION,
Royal Univ. of Malta, Valletta. Marine Biology Research Group.
For primary bibliographic entry see Field 07B.
W70-05089

STUDY OF A WATER-VAPOR ELECTROLYSIS UNIT,
Battelle Memorial Inst., Columbus, Ohio.
J. E. Clifford, B. C. Kim, and E. S. Kolic.
Report avail from Clearinghouse, as NASA CR-1531 - Price $3.00. National Aeronautics and Space Administration Contractor Report NASA CR-1531, March 1970. 38 p, 5 fig, 11 tab, 16 ref, 2 append. NASA Contract NAS 2-2156.

Descriptors: *Electrolysis, *Water reuse, *Oxygen, Ozone, Microorganisms, Systems analysis, Filtration, Activated carbon, Trace elements.
Identifiers: Oxygen production, Sulfuric acid.

Development of acid-type water-vapor electrolysis for oxygen generation in advanced life support systems involved detailed analysis of product gas purity. A sulfuric acid type water-vapor electrolysis module (1/4-man capacity) completed 100 days of satisfactory operation at design conditions. During an additional 45 days of evaluation the small generation rate of ozone and acid spray was controlled to well below the acceptable limits for continuous exposure by use of the usual charcoal and particulate filters used for trace-contaminant control. No other trace contaminants of concern were found in the oxygen (air) or hydrogen at a level of detection of 0.01 ppm. There was preliminary evidence that airborne bacteria were rapidly destroyed. Data on current/voltage relationships for individual cells of the module were obtained. (Knapp-USGS)
W70-05134

A REDUCED-SCALE METHOD FOR THE DETERMINATION OF THE DICHROMATE VALUE (CHEMICAL OXYGEN DEMAND) OF SEWAGE AND TRADE EFFLUENTS,
Nottingham Sewage Disposal Dept. (England).
R. J. Fearn, and W. H. Hetherington.
Journal Society Dyers Colurists, Vol. 83, p146-151, 1967. 9 tab, 8 ref.

Descriptors: *Analytical techniques, *Chemical oxygen demand, Chemical analysis.
Identifiers: *Textile mill wastes, *Dichromate value.

A description is given of a convenient and reliable analytical method for the determination of the dichromate value of sewage and trade effluents including those from textile mills. The method is more rapid than existing macro-scale procedures and is sufficiently analytically accurate and reproducible for the calculation of trade-waste treatment charges. Oxidation with potassium dichromate is carried out in boiling 50% (vol./vol.) sulfuric acid, with a total reagent volume of 30 ml. (Work-North Carolina State Univ)
W70-05148

EVALUATION OF WATER-QUALITY MONITORING IN THE ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07A.
W70-05170

RAPID POLAROGRAPHIC DETERMINATION OF CHLORINE, BROMINE AND IODINE IN ALGAE,
Trieste Univ. (Italy). Inst. of the Science of Properties and Qualities of Commercial Products.
C. Calzolari, L. Gabrielli, and G. Pertoldi Marletta.
Analyst, Vol 94, No 1122, p 774-779, September 1969. 6 p, 1 fig, 4 tab, 15 ref.

Descriptors: *Algae, *Chemical analysis, *Chlorine, *Analytical techniques, *Polarographic analysis, Photometry, Halogens.
Identifiers: Bromine, Iodine.

A rapid method is described for the polarographic determination of chlorine, bromine and iodine in algae after a single combustion procedure. For the determination of chlorine and iodine, the anodic waves of their ions were recorded. For bromine, on the other hand, the bromide ions were oxidized quantitatively to bromate ions, and the cathodic wave for these ions was recorded. The method has been tested on several species of algae from the Gulf of Trieste. (Knapp-USGS)
W70-05178

ON THE BIOLOGICAL SIGNIFICANCE OF PHOSPHATE ANALYSIS; COMPARISON OF STANDARD AND NEW METHODS WITH A BIOASSAY,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 05C.
W70-05269

APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY,
E. Geldreich.
Journal of the American Water Works Association, Vol 62, No 2, p 113-120, Feb 1970. 8 p, 53 ref.

Descriptors: *Recreation, *Bioindicators, *Water quality, *Bacteria, Aquatic bacteria, Aquatic microbiology, Aquatic microorganisms, Coliforms, Salmonella, Streptococcus, Water pollution, Water pollution sources, Pollutant identification, Path of pollutants, Animal wastes (Wildlife), Public health, Standards, Farm wastes, Water zoning, Sediment-water interfaces, Domestic wastes, Legal aspects, Sewage bacteria, Pathogenic bacteria.
Identifiers: *Fecal pollution.

Fecal contamination from all warm-blooded animals is the natural link to pathogenic microorganisms in polluted water. The fecal coliform test accurately detects and measures such fecal contamination. Use of the fecal coliform test as a measure of recreational water quality is recommended. Data and tables are given to show a correlation between fecal coliform and the probable occurance of Salmonella, an easily detecting pathogen. Court hearings are cited that establish the legal status of the fecal coliform test. The water-sediment interface of a stream or lake bottom can serve as a reservoir for fecal pollution 'fallout' from overlying water. The fecal-streptococcus group's diverse survival rates and specific fecal origins make them specific indicators for nonhuman, warm-blooded, animal pollution. Various minimal bacterial densities are suggested to insure good recreational water quality. (Cuevas-Florida)
W70-05332

A NEW MIDWATER TRAWL FOR SAMPLING DISCRETE DEPTH HORIZONS,
National Inst. of Oceanography, Wormley (England).
For primary bibliographic entry see Field 07B.
W70-05376

AIRBORNE FLUOROMETER APPLICABLE TO MARINE AND ESTUARINE STUDIES,
Geological Survey, Washington, D.C.; and Perkin-Elmer Corp., Norwalk, Conn.
For primary bibliographic entry see Field 07B.
W70-05377

ENUMERATION OF FRESHWATER PHYTOPLANKTON CONCENTRATED ON THE MEMBRANE FILTER,
Wisconsin Univ., Madison. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W70-05388

CHEMILUMINESCENT METHOD FOR DETECTING MICROORGANISMS IN WATER,
St. John's Univ., Jamaica, N.Y. Dept. of Biology.
Walter S. Oleniacz, Michael A. Pisano, Martin H. Rosenfeld, and Robert L. Elgart.
Environmental Science and Technology, Vol 2, No 11, p 1030-1033, 1968. 6 fig, 1 tab, 17 ref.

Descriptors: *Analytical techniques, *Microorganisms, *Water, Light, Radiation, Pseudomonas, Salmonella, Bacteria, Water pollution, Light intensity, Bioassay, Pollutant identification.
Identifiers: *Chemiluminescent method, Aerobacter aerogenes, Escherichia coli, Proteus mirabilis, Pseudomonas fluorescens, Salmonella typhimurium, Serratia marcescens, Bacillus subtilis, Alkaline luminol, Sodium perborate, Sodium pyrophosphate peroxide, Staphylococcus aureus.

The need for prompt information regarding presence of microorganisms in water instigated adaptation of a system designed initially for detection of biological aerosols. The analytical technique reported may be useful for monitoring water samples or other aqueous solutions in situations where a rapid indication whether microorganisms are present is required. It may have value as an adjunct or alternative to the plating techniques presently used in the examination of water for microbial content. Two automated systems were devised for the detection of microorganisms contained in water samples. The detection principle was based upon the measurement of light emission resulting from the interaction of microbial cells with alkaline luminol (5-amino-2,3-dihydro-1,4-phthalazinedione) in the presence of sodium perborate or sodium pyrophosphate peroxide. Each automated system detected 1000 to 100,000 viable bacterial cells/milliliter of water seeded with Aerobacter aerogenes, Escherichia coli, Proteus mirabilis, Pseudomonas fluorescens, Salmonella typhimurium, or Serratia marcescens. Maximum light emission occurred within one minute of the admixture of bacterial cells with the luminol reagent. The automated systems displayed linearity in response to varying cell numbers of each test organism. (Jones-Wisconsin)
W70-05391

A SMALL LABORATORY APPARATUS FOR MEASURING ACCELERATED LOSS RATES OF PESTICIDE DEPOSITS BY 'RAINWASHING',
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 07B.
W70-05400

CHLORINATED BIPHENYLS IN FISH, MUSSELS AND BIRDS FROM THE RIVER RHINE AND THE NETHERLANDS COASTAL AREA,
Utrecht Rijksuniversiteit (Netherlands). Inst. of Veterinary Pharmacology and Biological Toxicology.
J. H. Koeman, M. C. Ten Noever De Brauw, and R. H. De Vos.
Nature, Vol. 221, No. 5186, p. 1126-1128; 1969. 2 tab, 2 fig, 13 ref.

Descriptors: *Gas chromatography, *Analytical techniques, Spectrophotometry, DDT, Monitoring, Persistence, Birds, Toxicity, Mussels, Fish.
Identifiers: *Poly chlorinated biphenyls, *Mass spectrometry, Rhine River, DDD, DDE, Residues.

Polychlorinated biphenyls are widely used in industry, and they are now making an appearance in the world's wildlife. Besides being a hazard in their own right, they interfere with the gas chromatographic detection of organochlorine insecticides such as DDT. The occurrence and distribution of PCBs in the Rhine River, and the Netherlands coastal area is described. Identification by mass spectrometry and gas chromatography is elaborated on. The authors suggest continued monitoring of the area to prevent fatal concentrations from occurring. (Sjolseth-Washington)
W70-05425

EVALUATING RISKS OF PESTICIDES TO FISH,
Water Pollution Research Lab., Stevenage (England).
John S. Alabaster.
Proceeding 5th British Insecticide and Fungicide Conference, 1969, p 370-377, 12 ref, 3 fig.

Descriptors: *Pesticides, Bioassay, *Test procedures, *Laboratory tests, *Evaluation, Fish behavior, Toxicity, *Fish, Pesticide toxicity, Analytical techniques, Fish food organisms, Risks, Methodology.
Identifiers: Pesticide uptake, *Long term effects, Residue accumulation.

General requirements for measuring the toxicity of pesticides to fish are outlined, together with the standard test developed by the British Ministry of Agriculture, Fisheries and Food. Tests are discussed in relation to their usefulness for screening purposes and for predicting the effect of pesticides on fisheries under field conditions. Experiments on the uptake of organo-chlorine pesticides by fish are described. (Sjolseth and Katz-Washington)
W70-05431

BIOLOGICAL PRODUCTION AND DISTRIBUTION OF CARBON DIOXIDE IN WOODS HOLE WATERS,
Woods Hole Oceanographic Institution, Mass.
John M. Teal.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 336-340, 1967. 5 p, 3 fig, 2 tab, 4 ref. NSF Grant No GB539.

Descriptors: *Biomass, *Carbon dioxide, Productivity, Photosynthesis, Respiration.
Identifiers: *Woods Hole, Gulf of Maine, Buzzards Bay.

The balance between photosynthesis and respiration taking place in water can be monitored by following changes in carbon dioxide. The distribution of carbon dioxide was measured for the Gulf of Maine, Eel Pond, Woods Hole, and in the water of a salt marsh on Buzzards Bay. In the Gulf of Maine, phytoplankton patchiness was apparent from the patchiness of carbon dioxide distribution. Net carbon production and photosynthesis values were calculated for Woods Hole waters from carbon dioxide content and chlorophyll-a measurements. Net production was positive from December or late November through March. There was a rapid change to negative values in early spring and high negative net production throughout the summer. (Carstea-USGS)
W70-05540

5B. Sources of Pollution

SELF-PURIFICATION OF THE SURFACE WATERS POLLUTED BY WASTE WATER OF THE FOOD INDUSTRY (UNDER CO-INFLUENCE OF BANK PLANTS). (IN GERMAN),
K. Skalski.
Verh. Internat. Verein. Limnol., Vol XIV, p 1054-1056, July, 1961. 4 p, 2 fig.

Descriptors: *Self-purification, *Biochemical oxygen demand, *Dissolved oxygen, *Temperature, Water quality, Saturation, Industrial wastes, Streams, Rivers, Willow tree.
Identifiers: Waste water effects.

Analyses of water quality of the stream Dabrovka (Poland), polluted by a fruit processing factory, is presented. The water quality changes were investigated in a reach of the stream 1.6 km. long below the effluent outfall. In the middle part of this reach a great occurrence of willow growths (Salix viminalis and Salix americana) exists on both sides of the river. The water quality parameters investigated were BOD sub 5 and oxygen saturation, expressed in %. According to these parameters, very quick self-purification occurred - 93.9% removal of BOD sub 5 at a temperature of 17.2 deg C in August, 89.0% removal of BOD sub 5 at an average temperature of 13.0 deg C in September, and 90.7% removal of BOD sub 5 at a temperature of 7.7 deg C in October. The DO dropped to zero in the first part of the reach and recovered in the following sections. This occurred in all cases investigated. The correlation between the self-purification rate and the density of willow growth was observed and explained from the standpoint that the roots of willow form a good environment for organisms effecting self-purification. (Novotny-Vanderbilt)
W70-05047

TEMPERATURE VARIATIONS IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.; and California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 02H.
W70-05053

PERSISTENT PESTICIDES IN THE ENVIRONMENT,
Rothamsted Experimental Station, Harpenden (England); and Minnesota Univ., St. Paul. Inst. of Agriculture.
For primary bibliographic entry see Field 05C.
W70-05057

PHYSICAL AND ENGINEERING ASPECTS OF THERMAL POLLUTION,
Vanderbilt Univ., Nashville, Tenn.; and New York State Dept. of Health, Albany.
For primary bibliographic entry see Field 05C.
W70-05059

OBJECTIVE ANALYSIS OF THE STRONTIUM-90 CONCENTRATION FIELD IN THE ATLANTIC OCEAN,
Akademiya Nauk URSR, Kiev. Morskyi Hidrofizychnyi Instytut.
For primary bibliographic entry see Field 05A.
W70-05069

A SOLUTION OF THE COTTON SIZING WASTES PROBLEM,
Hercules Powder Co., Wilmington, Del.
B. W. Dickerson.
Industrial Wastes, Vol. 1, p10-18, 1955. 7 tab, 6 fig.

Descriptors: *Cotton, Biochemical Oxygen Demand, Trickling filters.
Identifiers: *Starch, *Carboxymethyl cellulose, *Warp sizing, Desizing, Textile mill wastes, Dyehouse wastes.

The BOD loads from cotton dyeing and finishing plants vary from 3000 to 30,000 lb/day and waste flows range from 2 mgd to 15 mgd. The major source of BOD is the corn starch used as a warp sizing. The waste water from desizing, may be treated either by chemical precipitation or by biological oxidation using a combination of percolating filters and activated sludge. Experiments were made to determine to what degree BOD can be reduced by using mixtures of starch and carboxymethyl cellulose (CMC). It was found that CMC had a five-day BOD value of 11, whilst the five-day BOD of starch was 812. The CMC does not require an enzyme for desizing and needs only 1/2 of the usual amount of wash water. Pilot-plant studies were made using percolating filters one unit being fed a mixture of sewage, one a mixture of CMC in sewage, and one a mixture of starch in sewage. It has been found that the use of a mixture with 65% starch and 35% CMC in place of starch alone, although being costly in the first instance, gives an appreciable decrease in cost of waste water treatment. The cotton fabric produced by this method is equal to or better than the previous product. Where over-all reductions of BOD value of 30-40% are required, the use of the starch-CMC mixture may result in the elimination of any treatment plant. (Work-North Carolina State Univ)
W70-05075

EUTROPHICATION AND DETERGENTS,
Southam Business Publications Ltd., Don Mills (Ontario). Reader Service Dept; and Toronto Univ. (Ontario).
P. H. Jones, and Tom Davey.
Water and Pollution Control, Vol 106, No 9, p 22-25, 46, September 1968.

Descriptors: *Eutrophication, Phosphorus, *Detergents, Domestic wastes, Pollutants, Water pollution sources, Water quality, Algae, Sewage effluents.
Identifiers: Polyphosphates, Nutrient balance, Foaming detergents, Public apprehension.

Detergents are attacked as a major nutrient source in eutrophication. Soluble polyphosphates serving as filler in detergents help upset nutrient balances in lakes and stimulate algal growth. Other significant sources of biologically active phosphorus are animal and human waste. Because most detergents contain 50% polyphosphates, sewage effluent phosphate has doubled or tripled. Substitute fillers for polyphosphates, which can act as chelating agents and control pH, are now available. Replacing phosphorus in detergents would have an instantaneous beneficial effect at a cost of an extra 15-20 cents a box. Public pressure could force the desired change. Excess phosphorus accelerates a lake's natural aging process. (Bannerman-Wisconsin)
W70-05084

PHOSPHORUS AND WATER POLLUTION,
Agricultural Research Service, Beltsville, Md. Soils Lab.
Alan W. Taylor.
Journal of Soil and Water Conservation, p 228-231, November-December 1967. 4 tab, 26 ref.

Descriptors: *Phosphorus, *Groundwater, *Water pollution sources, Sewage effluents, Eutrophication, Irrigation, Water pollution control, Water chemistry.
Identifiers: Manure, Feedlots, Phosphorus sources, Agricultural fertilizers.

Phosphorus, an important nutrient in natural water, will stimulate excess growth at 0.05 ppm. It is quickly converted to insoluble form in soil and strong sorbtion by soil particles almost completely immobilize it. Pollution from groundwater phosphorus is therefore minimal even though irrigation drainage may cause phosphorus concentration of .08 ppm in groundwater. Eroding topsoils can contribute phosphorus to natural water. Unlike spasmodic erosion flow, manure in stockyards and manure piles supply a steady flow of relatively high phosphorus concentration in available form. Phosphorus pollution from feedlots is significant because concentration of output. Measuring total phosphorus concentration in a water body does not indicate phosphorus available for growth, which is a small fraction of the total. Continuous monitoring of total and available phosphorus concentrations are necessary to assess nutrient sources. One pound of phosphorus dissolved in one acre-foot of water yields a concentration of 0.03 ppm. Phosphorus contamination from sewage effluent is significant, based on a per capita consumption of 2.5 lbs of phosphorus. (Bannerman-Wisconsin)
W70-05098

NITRATES IN THE ENVIRONMENT,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02K.
W70-05099

EFFECT OF STARCH SUBSTITUTES ON TEXTILE WASTES,
J. A. McCarthy.
Sanitalk, Vol. 4, No. 1, p23-25, 1955.

Descriptors: *Waste treatment, Biochemical Oxygen Demand, Cost analysis.
Identifiers: *Carboxymethyl cellulose, *Textile mill wastes, *Starch, Starch substitutes, *Percolating

filters, Textile wastes, Critical Micelle Concentration, Pollutional load discharge.

The extensive use of starch in the processing of textiles, the processes involved, and the high BOD of textile waste waters resulting from its use are outlined. Investigations made at the Lawrence Experiment Station, Massachusetts, on the BOD of starch solutions and solutions of starch substitutes made up to 0.1% solutions, as used in textile mills, showed that whereas the BOD of starch solutions averaged from 600 to 1000 ppm, figures for substitutes were considerably lower, and that in mixtures of starch and CMC exertion of the BOD was retarded. The efficiency of treatment of starch and CMC mixtures on percolating filters was also studied. It was concluded that a reduction in the BOD of textile waste waters could be effected by the use of starch substitutes, giving a reduction in the pollutional load discharge to streams and a reduction in the cost of textile waste treatment. (Mattox, Livengood-North Carolina State Univ)
W70-05156

MINE DRAINAGE IN THE NORTH BRANCH POTOMAC RIVER BASIN,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
For primary bibliographic entry see Field 05C.
W70-05176

THERMOPHILIC BLUE-GREEN ALGAE AND THE THERMAL ENVIRONMENT,
Oregon Univ., Eugene. Dept. of Biology.
Richard W. Castenholz.
Bacteriological Reviews, Vol 33, No 4, p 476-504, 1969. 4 fig, 4 tab, 187 ref.

Descriptors: *Cyanophyta, *Algae, *Thermal springs, *Oregon, Thermophilic bacteria, Thermao pollution, Nutrients, Temperature, Photosynthesis, Light intensity.
Identifiers: *Yellowstone Park, *Iceland, Mastigocladus laminosus, Phormidium laminosum, Oscillatoria tenuis, Oscillatoria terebriformis, Mats, Synechococcus lividus, Blue-green algae, Filaments.

The blue-green algae in general have higher temperature optima than other algae and some of them, the thermophiles, and inhabitants of hot springs at temperatures as high as 73-74C. It is no surprise, therefore, that thermal pollution may favor the growth of the blue-green algae. Waters from hot springs generally possess much greater solute (nutrient) concentrations than surface waters and it is probable that many thermal streams cause eutrophication in the bodies of water into which they drain. The paper covers the following topics: distribution of thermal waters; distribution of species (upper and lower temperature limits, classification and geographical distribution, problems of survival and transport); studies of natural populations (mat formation and stability, movements of filaments and mats, measurements of photosynthesis and growth); cultivation of thermophilic cyanophytes (mediums and nutrition, isolation and maintenance, rates of growth, rates of photosynthesis, and respiration rates in culture); responses to temperature and light intensity (optimal temperature and light intensity, effects of light and temperature on pigmentation, growth and survival at suboptimal temperatures). (Gerhold-Wisconsin)
W70-05270

HOUSEHOLD WASTE WATER,
National Swedish Inst. for Building Research, Stockholm.
Eskil Olsson, Lars Karlgren, and Victor Tullander.
Available from the Clearinghouse as PB-184 598, $3 in paper copy, 65 cents in microfiche. Report, Byggforskningen-24:1968. 161 p, 98 tab, 36 fig, 58 ref.

Descriptors: *Biochemical oxygen demand, Chemical contamination, Degradation (Decomposition), Phosphorus, Oxygen, Domestic wastes, *Domestic water, Water pollution sources, Municipal wastes.
Identifiers: Sweden, *Grey water, *Household wastewater.

The purpose of this investigation, has been to obtain information about the quantity and nature of waste water from dwelling houses. The results provide a basis for estimating the loading capacity of recipients and the necessary sewage treatment procedures as well as the scaling of drainage networks and treatment plants. However, the principal interest was devoted to a careful analysis of grey water, since information about such water is imperfect. Biochemical oxygen demand, BOD5, was determined every day. A number of BOD curves have been compiled in order to make it possible to assess the rate of reaction and the various steps of decomposition. From the results it is evident that special attention must be paid to the grey water, since it is the grey water that supplies such a large proportion of primary (=direct)pollution.
W70-05304

REVIEW ON TOXIGENIC ALGAE,
Hebrew Univ., Jerusalem (Israel).
Moshe Shilo.
Verhandlungen der Internationalen Vereinigung fur Theorestische und Angewandte Limnologie, Vol 15, p 782-795, 1964. 90 ref, discussion.

Descriptors: *Toxicity, *Algae, *Reviews, Habitats, Clams, Mussels, Shellfish, Dinoflagellates, Cyanophyta, Chrysophyta, California, United States, Brackish water, Estuaries, Bacteria, Mollusks, Vitamin B, Red tide, Salinity, Florida, Texas, Phosphorus, Migration, Diurnal, Algicides, Clostridium, Fish, Amphibians, Anabaena, Cytological studies, Physicochemical properties.
Identifiers: Gonyaulax, Gonyaulax venificum, Pyrodinium, Gymnodinium breve, Canada, Europe, South Africa, Israel, Microcystis, Prymnesium parvum, Synergistic effects, Axenic cultures, Monoalgal, Portugal, Tapes, Japan, Amphidinium, Blooms, Mytilus, Trichodesmium erythreum, Saxidomus, Clostridium botulinus, Venerupis, Ostrea, Arthropods.

Toxigenic algae are found in marine, brackish and fresh water worldwide. High concentrations of toxin-forming organisms, stored in clams, mussels, and shellfish cause food poisoning. Different taxonomic groups contain toxin-forming algae--some Dinoflagellates, certain blue-green algae, and one species of Chrysophyceae. Relationship between algal appearance and toxic phenomena did not prove unequivocally that toxin-formation is caused by algae themselves. Many forms in toxic tides and blooms are now available in axenic culture. Mass development of toxic algae being sporadic, investigators seek for critical combination of physicochemical factors triggering them. Blooms have been associated with upwelling of deep, cool, nutrient-rich water, heavy rainfall with river discharge, sewage pollution, phosphorus concentrations, growth-promoting substances formed by microorganisms, salinity, active or passive concentrations of the cells after growth. Properties and behavior of algal toxins are described. Lack of correlation between concentration of potentially toxic algae and level of toxins in water is emphasized. Intra-and extra-cellular concentrations of toxic principles in axenic Prymnesium cultures varied with stages of growth. Optimal growth conditions were not necessarily optimal for toxin biosynthesis. Shifting concentrations of co-factors, such as streptomycin, spermine, and others as yet unknown may alter toxic effect without changes in toxin level. (Jones-Wisconsin)
W70-05372

MAN, WATER, AND ENVIRONMENT,
Water Pollution Research and Applications, Inc., Washington, D.C.
Jacob I. Bregman.
Archives for Environmental Health, Vol 20, p 100-104, January 1970.

Descriptors: *Water quality control, *Standards, *Laws, Federal jurisdiction, Legislation, Project planning, Water policy.
Identifiers: Drinking water standards, Public Health Service, Congress, Water quality standards, Federal clean-water aids.

Some contributing factors in US water pollution have been population growth, urbanization and suburbanization, industrial expansion, higher incomes and expectations, and untested use of new technology. 1965-66 saw two major water pollution bills passed by Congress. The national cleanup program is administered by the Department of the Interior, which is in charge of developing water quality standards, providing aid for comprehensive planning, research, and waste treatment plants, and providing legal enforcement when incentives fail. The states have the task of deciding goals, determining what levels of pollution are consistent with the goals, and setting schedules. Some Department of Interior policies are that there should be no degradation of existing water quality, no waters shall be used solely or principally as a waste carrier, all wastes given 'best' practicable treatment prior to discharge, consistency of standards among adjoining and downstream states, standards must anticipate population and industrial growth, no exceptions to particular industries or areas, and standards should be feasible and achievable. (Powers-Wisconsin)
W70-05384

GAS CHROMATOGRAPHIC CHARACTERISTICS OF CHLORDANE. I. EFFECT OF AN AQUEOUS ENVIRONMENT ON THE HEPTACHLOR COMPONENT,
Hawaii Univ., Honolulu. Dept. of Agricultural Biochemistry; and Hawaii Univ., Honolulu. Dept. of Food Science and Technology.
Arthur Bevenue, and Chee Yee Yeo.
Bulletin of Environmental Contamination and Toxicology, Vol 4, No 2, p 68-76, 1969. 1 fig, 15 ref.

Descriptors: *Pesticides, *Pesticide toxicity, *Heptachlor, Chemicals, Gas chromatography, Crops, Soil contamination effects, Water pollution effects, Bioassay, Chlorinated hydrocarbon pesticides.
Identifiers: *Chlordane, Biocides, Diels-Alder adduct.

A marked decrease in the heptachlor component of chlordane was recorded during the first 24 hours exposure of the biocide to water. After 14 days, the content of heptachlor decreased to nearly zero from 1 ppm solution. Water exposed for 14 days to chlordane vapors was enriched in heptachlor. The claim that heptachlor in water is rapidly converted to heptochlor epoxide is the disagreement with the findings obtained with distilled water. The gamma and alpha fractions of the biocide might be used to quantitate residues of chlordane in crops, soil, and water. The changes in commercial chlordane, revealed in this study, most likely would influence chromatographic results obtained by analyses of blood, urine, and tissue samples in cases related to ill effects produced by exposure to chlordane. (Wilde-Wisconsin)
W70-05403

CHAPTER XII: RECEIVING-WATER MONITORING: KEY TO SEATTLE METRO'S POLLUTION-ABATEMENT PROGRAM,
Seattle Metropolitan Municipality, Wash.
Charles V. Gibbs.
In: Water Resources Management and Public Policy, ed. Thomas H. Campbell and Robert O. Sylvester, Seattle, University of Washington Press, 1968, p. 179-186, 1 fig.

Descriptors: *Monitoring, *Pollution abatement, *Data processing, Planning, Conservation, Fisheries, Industrial wastes, Fresh water, Saline water, Ecology, Costs, Benefits.

Identifiers: *Metro, *Green-Duwamish River program, *Puget Sound, U.S. Geological Suryey, *Lake Washington Ship Canal, State regulatory agencies, Review requirements, Pollution Control Commission, Water Quality Control Division, Effluent disposal, Pacific Ocean.

The pollution abatement and prevention program undertaken by the municipality of Metropolitan Seattle (Metro) in 1959 is outlined. Working under the philosophy that a discharger has the responsibilities for monitoring its receiving waters, Metro has established a Water Quality Control Division and has assigned it the task of planning and implementing the necessary programs. Cost for the entire program ($135 million by 1972) and costs and benefits for specific aspects of it are indicated. Water-quality monitoring was recognized at the outset to be of critical importance because of conservationists' opposition regarding effluent disposal when the plan was presented to state regulatory agencies in 1960. The monitoring and review requirements established by the Pollution Control Commission are outlined along with a set of six objectives of the Metro program. Three divisions of the program--a Water Quality Section, an Ecological Section, and an Industrial Waste Section--are pointed out and the distinct problems at each of the four separate monitoring programs indicated. The Green-Duwamish River program involves a freshwater stream and its terminal estuary. Puget Sound is an arm of the Pacific Ocean. Lake Washington-Lake Sammamish drainage basin requires work on the large lakes and many small tributary streams. Lake Washington Ship Canal system necessitates work on several small lakes connected by deep water canals influenced by intrusion of salt-water. Cooperative studies with the U.S. Geological Survey are mentioned and details of the electronic data-processing system presented. (See W70-03995). (Preckwinkle-Chicago)
W70-05452

CHAPTER XIII: PULP-MILL WASTE-WATER DISCHARGES INTO PUGET SOUND: AN INDUSTRY VIEWPOINT,
Northwest Pulp and Paper Association, Seattle, Wash.
Donald J. Benson.
In: Water Resources Management and Public Policy, ed. Thomas H. Campbell and Robert O. Sylvester, University of Washington Press, 1968, p. 187-195.

Descriptors: *Water quality control, *Water pollution control, *Beneficial use, *Downstream, *Pollutants, *Water Quality Act, *Sites, *Waste disposal, *Zoning, *Standards, Legal aspects.
Identifiers: *Puget Sound, *Washington State, *Continuous assessments, Pollution Control Act, Pollution Control Commission, Public Law 660, FWPCA, Water quality criteria.

Review of legal and technical issues related to pulp-mill waste-water discharges into Puget Sound suggests that philosophical as well as technical questions appear to be at the heart of the problem. The term 'water-pollution control' needs to be replaced by 'water-quality control.' A basic concept of water-quality control is the theory of downstream beneficial use. This means that the residents upstream will control discharges so that beneficial uses downstream are not impaired. Categories of beneficial use are listed in addition to types of contaminants that can reduce water quality below beneficial use levels. A two-pronged approach to enforcement of the beneficial use theory is presented including continuous assessment of water quality and beneficial uses with waste-discharge requirements dependent upon these stream determinants. 'Known and reasonable' methods of control are suggested and the salesmanship approach is averred to be more successful than legal proceedings. Complications with the theory of downstream beneficial use are illustrated by instances in which a second mill is located on a stream where satisfactory requirements were being met by a first mill. Technical means of reducing polluted flow are mentioned and zoning proposed for land and water based on forecasts of future basin water requirements in supporting particular potential kinds of industry. Public hearings required by the Federal Water Quality Act of 1965 are held to recognize proper water quality criteria principles and the highly technical engineering matters involved. (See W70-03995). (Preckwinkle-Chicago)
W70-05453

THE MOVEMENT OF BACTERIA AND VIRUSES THROUGH POROUS MEDIA,
Colorado Div. of Water Resources, Denver. Ground Water Section.
John C. Romero.
Ground Water, Vol 8, No 2, p 37-48, March-April 1970. 12 p, 3 fig, 4 tab, 26 ref, append.

Descriptors: *Path of pollutants, *Bacteria, *Viruses, *Porous media, *Groundwater movement, Seepage, Water pollution sources, Filtration, Reviews, Surveys, Sanitary engineering, Waste disposal.
Identifiers: Well sanitation.

This report is the result of a request by the State Board of Examiners of Water Well and Pump Installation Contractors. The Board is in the process of formulating a more reasonable set of guidelines which control the location of wells designed to produce water for human consumption and/or food processing with respect to potential or existing sources of ground-water pollution. The pollution of groundwater supplies appears belatedly and often is not recognized until a relatively large area has been contaminated. Soils and aquifer materials have capacity to remove or 'filter' some types of contaminants. The results of several pertinent groundwater pollution investigations are briefly described and current and potential standards for governing 'safe distances' between domestic-food processing wells and sources of potential or existing pollution are given. The recommendations are meant to emphasize the fact that no one set of distances are adequate and reasonable for all conditions. Whenever possible the safe-distance between a subject well and a source of potential or existing pollution should be based on local conditions. It is important that we develop knowledge that will permit continued use of the soil mantle as a waste-water treatment system and at the same time permit continued use of ground water for human consumption and/or food processing. Functional legal, administrative and engineering mechanisms must be developed to maintain this combined usage. (Knapp-USGS)
W70-05477

THE ESTUARY--SEPTIC TANK OF THE MAGALOPOLIS,
Public Health Service, Metuchen, N.J. Div. of Water Supply and Pollution Control.
Paul De Falco, Jr.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 701-703, 1967. 3 p.

Descriptors: *Estuaries, *Water pollution sources, *Water pollution control, Pollutants, Chemical oxygen demand, Storm runoff, Pesticides, Fertilizers, Industrial wastes, Municipal wastes, Analytical techniques, Membranes, Filters, Septic tanks.
Identifiers: Raritan Bay project, Estuarine pollution.

The sources of pollution in estuaries such as storm-water overflow and drainage from suburban areas with fertilizers and pesticides are discussed. Many oyster and clam beds, fisheries, and recreational areas along the main estuaries of the United States have disappeared or cannot be used due to water pollution. Sanitary engineers, microbiologists and biologists are faced with serious problems in their fight to hold the ground against pollution. The complex combination of municipal and industrial wastes with salt water is difficult to characterize. New methodology was developed in the Raritan Bay project. Among the new methods listed are a modified chemical oxygen demand test; a modified mitrate-nitrite test; use of membrane filter; method for separation of pollution-tolerant organisms in marine waters. (Carstea-USGS)
W70-05537

TECHNICAL APPROACHES TOWARD EVALUATING ESTUARINE POLLUTION PROBLEMS,
Public Health Service, Portland, Oreg. Div of Water Supply and Pollution Control; and Washington State Dept. of Fisheries, Brinnon. Shellfish Lab.
For primary bibliographic entry see Field 05C.
W70-05538

THE ROLE OF MAN IN ESTUARINE PROCESSES,
Maryland Univ., Solomons. Natural Resources Inst.
L. Eugene Cronin.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 667-689, 1967. 23 p, 5 fig, 125 ref.

Descriptors: *Estuaries, *Water pollution, *Water management (Applied), Water quality, Research and development, Silting, Dams, Barriers, Spillways, Engineering structures, Levees, Diversion, Thermal pollution, Salinity, Nutrients, Radioactive wastes, Pulp wastes.
Identifiers: Bonnet Carre Spillway, Potomac River, Delaware diversion.

Human activity upstream which modifies estuaries includes modification of river flow, organic enrichment, dams and barriers, spillways, and diversions. In estuaries, man's modifications include: physical processes such as landfill, thermal pollution, salinity change, and modifications of basins; and chemical processes such as use of biocides, nutrient enrichment, and radioactive wastes. Among the biological processes, human predation (fishing) and artificial introduction of species are reviewed. Basic research in this complex and challenging estuarine environment is critically needed. Intelligent management, research, and public education are vital to the optimal future use of estuaries. (Carstea-USGS)
W70-05539

5C. Effects of Pollution

FORMATION AND MAINTENANCE OF THERMOCLINES IN STRATIFIED LAKES INCLUDING THE EFFECTS OF POWER PLANT THERMAL DISCHARGES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
T. R. Sundaram, and R. G. Rehm.
AIAA Paper No. 70-238, AIAA 8th Aerospace Sciences Meeting, New York, January 19-21, 1970. 14 p, 9 fig, 36 ref.

Descriptors: *Thermal pollution, *Temperature, *Stratification, Thermocline, Turbulence, Winds, Thermal power plants, Diffusivity, Mathematical model.
Identifiers: Richardson number, Friction velocity.

Temperate lakes generally exhibit a vertical thermal structure which is characterized by a nearly homothermal upper layer with a sharply defined lower boundary (the thermocline). Under the assumption of horizontal homogeneity (deep lake), the equation describing the vertical transport of heat is (partial differential of T)/ (part. diff. t) = ((part. diff.)/ (part. diff. Z)) ((K sub H) ((part. diff. T)/ (part. diff. Z))) where T is the temperature, t is the time, Z is the distance measured downward from the surface and K sub H is eddy diffusivity for the vertical transport of heat. The influence on the eddy diffusivities of the interaction between the turbulence structure and the buoyancy gradients was included. The nonlinear equations of the problem were then solved using an electronic

computer. It is shown that, while the vertical temperature profile at the start of warming season is fairly smooth, the thermocline is soon formed by nonlinear interaction between wind induced turbulence and stable buoyancy gradients due to surface heating. It is also demonstrated that continuous downward erosion of the thermocline into the deeper layers of the lake is a necessary part of its sustenance. It is observed that, if the effect of thermal discharges is to cause either an increase in temperature or in heat flux, then the time of formation of the thermocline, as well as its depth, are reduced. (Upadhyaya-Vanderbilt)
W70-05050

INFLUENCE OF TEMPERATURE REGIME ON THE SELF-PURIFICATION PHENOMENON OF STREAMS. (IN RUMANIAN),
Hydrological Research Inst., Bucharest (Rumania).
J. Pietraru.
Russian, English, French, and German summaries.
Hydrotechnica, Gospodarirea Apelor, Meteorologia, Vol. 12, No. 4, April 1967, p. 194-199, 5 fig., 3 ref.

Descriptors: *Temperature, *Self-purification, Water quality, Water pollution, Water utilization, Water policy, Water resources, Water pollution treatment, Reaeration, Waste assimilative capacity, Path of pollutants, Heated water.

Temperature regime influence on self-purification of the river Arges is described. Temperature data were summarized to get the overall picture about the seasonal changes of the stream temperature and the evaluation of data was used for establishing the necessary treatment degrees in the river basin. For this computation, the thermal factor Theta defined by Streeter and Phelps was used both for deoxygenation computation (Theta = 1.047) and for reaeration (Theta = 1.0159). After those theoretical considerations, the parameters for that computation which are proposed to be used in Rumania are presented and discussed. (Novotny-Vanderbilt)
W70-05054

INFLUENCE OF THERMAL POWER PLANTS ON STREAMS. (IN FRENCH),
Electricite de France. Service de la Production Thermique.
A. Goubet.
Delegation Generale au District de la Region de Paris, December, 1965, 115 p.

Descriptors: *Thermal pollution, *Temperature, *Thermal power plants, *Cooling water, *Streams, Thermal properties, Thermal stratification, Dissolved oxygen, Water pollution, Self-purification, Chemical properties, Biological properties, Bacteria, Mixing, Weather data, Thermodynamic behavior, Equilibrium, Heated water.

This report deals with determination and analysis of the influence of four steam electric power stations on streams below the stations. The report is divided into 7 parts. First it contains the statistical temperature analysis of each of the four streams. The mixing of waters with different temperatures is discussed in the second part. The author's conclusion is that from the standpoint of influence on aquatic life, the average cross-sectional temperature should be the main parameter. The effect of cooling in the channel and streams is solved in the third part. The author used the formula Theta = Theta sub o exp (Lx/QD) where the thermal exchange coefficient D is the recommended value of D = 75. In this equation Theta sub o is an initial temperature difference between the actual water temperature and the temperature which would occur if no heat pollution existed; Q is the discharge of water in the stream, (m cu.)/sec; x is the distance downstream in km; L is the width of the river in m, and D is a constant dependent on meteorological conditions. The following parts deal with the influence of power stations on chemical and biological properties. The change of oxygen content of water passing through the cooling cycle is negligible. The influence on other chemical substances and similarly on biological and bacteriological properties has not been proved. (Novotny-Vanderbilt)
W70-05055

PERSISTENT PESTICIDES IN THE ENVIRONMENT,
Rothamsted Experimental Station, Harpenden (England); and Minnesota Univ., St. Paul. Inst. of Agriculture.
Clive A. Edwards, and Russell S. Adams.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 7-67, February 1970. 61 p, 3 fig, 22 tab, 297 ref.

Descriptors: *Pesticide residues, *Hazards, *Pollutants, *Reviews, Bibliographies, Fishkill, Pesticide kinetics, Distribution patterns, Path of pollutants, Pesticide toxicity, Pesticide removal, Public health, Water pollution sources, Pesticide drift, Water quality, Environment, Ecology.
Identifiers: Persistent pesticides.

The results are summarized of some of the more important pesticide residue surveys and experimental studies of residues in both the physical and biological sections of the environment, in order to assess the present state of knowledge of the status of pesticide residues in the environment. Recent data are presented on the amounts of residues in all compartments of the environment to show how they are concentrated from the physical to the biological parts of the environment and into the upper trophic levels of food chains. The most difficult thing to assess from data currently available is not what the present situation is, but what changes will occur if certain actions, for example a ban on a particular pesticide, are taken. The cycling of pesticides in the environment is summarized to illustrate the movements of residues through the various compartments of the environment. A bibliography of 297 entries is included. (Knapp-USGS)
W70-05057

CHANGING PRACTICES IN AGRICULTURE AND THEIR EFFECT ON THE ENVIRONMENT,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering; and California Univ., Davis. Dept. of Agricultural Engineering.
Raymond C. Loehr, and Samuel A. Hart.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 69-99, February 1970. 31 p, 7 fig, 9 tab, 67 ref.

Descriptors: *Reviews, *Bibliographies, *Water pollution sources, *Farm wastes, Waste treatment, Aesthetics, Odors, Sewage disposal, Disposal, Farm management, Water pollution control, Environment, Water quality, Air pollution, Urbanization.
Identifiers: Animal production wastes.

This review emphasizes one facet of agriculture, animal production as an example of the changes that have taken place in agriculture. The major topic areas include: productivity increases, changes in size of operations, handling problems, waste characteristics, surface and groundwater quality, land application of wastes, land runoff, odor production, and waste management techniques. Because farms are located in relative isolation surrounded by apparently unlimited land, air, and water, contaminants generated by agriculture usually would be sufficiently dilute or stabilized before potential problems become real. Modern developments in agriculture and growing recreational use of rural lands are tending to eliminate this relative isolation. The large livestock producer is in the animal rather than in the crop-farming business. He relies on commercially available feeds for a considerable portion if not all of his feeding requirements, has a minimum interest in utilization of the resultant manure in crop production, and may not have adequate land of his own for satisfactory disposal of the animal wastes. The outlook is for continuation of these trends in modern agriculture and for an increase in the environmental problems described in this review. No new facility or expansion of existing facilities for agricultural production should be considered without prior planning which should include the probable environmental effects of the disposal of wastes from the facility. (Knapp-USGS)
W70-05058

PHYSICAL AND ENGINEERING ASPECTS OF THERMAL POLLUTION,
Vanderbilt Univ., Nashville, Tenn.; and New York State Dept. of Health, Albany.
Frank L. Parker, Peter A. Krenkel, and Donald B. Stevens.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 101-192, February 1970. 92 p, 13 fig, 14 tab, 423 ref.

Descriptors: *Water pollution effects, *Thermal pollution, *Reviews, *Bibliographies, Environment, Aquatic environment, Water temperature, Aquatic habitats, Regulation, Standards, Water Quality Act, Water quality, Costs, Water pollution control.
Identifiers: Thermal pollution effects.

The rate of growth of cooling water requirements with particular reference to central electricity generating stations, the possibilities of improved efficiencies in electricity production, the limited availability of cooling water and the mechanisms and means of heat dissipation are detailed. Also described are the effects of heated discharges upon the biota and the hydrodynamics of the receiving waters. It has been shown that new plant sizes will be such that only in a few areas of the country will we be able to meet biologically derived standards if run of the river cooling is used. It has also been shown that expectations of increased flow or reduced cooling requirements due to increased thermal efficiencies are not likely to be realized. We cannot expect to find sufficient beneficial uses of the degraded heat to substantially diminish the problem. The choice will be whether to pay the price for preventing the excess heating of our surface waters or to accept the consequences of discharging these heated effluents and let them take their toll. A bibliography of 423 entries is included. (Knapp-USGS)
W70-05059

GEOCHEMICAL ENVIRONMENTS AND CARDIOVASCULAR MORTALITY RATES IN GEORGIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02K.
W70-05067

THE INFLUENCE OF NITROGEN ON HETEROCYST PRODUCTION IN BLUE-GREEN ALGAE,
Bureau of Commercial Fisheries, Ann Arbor, Mich. Biological Lab.
Roann E. Ogawa, and John F. Carr.
Limnology and Oceanography, Vol 14, No 3, p 342-351, 1969. 7 fig, 4 tab, 26 ref.

Descriptors: *Algae, *Cyanophyta, *Nitrogen fixation, Nutrients, Lake Erie.
Identifiers: *Heterocysts, Anabaena variabilis, Microcystis aeruginosa, Aphanizomenon flos-aquae, Oscillatoria, Anabaena cylindrica B629, Anabaena inaequalis 381, Anabaena flos aquae, Tolypothrix distorta, Gloeotrichia echinulata LB 1303.

Indirect evidence is presented suggesting involvement of heterocysts in utilization of atmospheric nitrogen as sole nitrogen source for algae. Seven heterocystous (known atmospheric nitrogen-fixing) blue-green algae were grown in a modified Chu No 10 medium devoid of combined nitrogen; two non-heterocystous (non-atmospheric-fixing) blue-greens did not grow in this medium. Hetero-

cysts were produced shortly after inocula devoid of heterocysts were placed in nitorgen-free medium. Production was greatest when atmospheric nitorgen served as sole nitrogen source, and least when ammonia-nitrogen served as sole nitrogen-source. Nitrate-nitrogen produced an intermediate number of heterocysts. When medium nitrate-nitrogen content was varied as sole nitrogen source, numbers of heterocysts produced were inversely proportional to the nitrogen concentration. They did not develop in the absence of phosphorus, but no effort was made to determine the critical phosphorus concentration for their production. Production of heterocysts in circumstances of low combined nitrogen may provide an ecological advantage. The relative numbers of heterocysts in field-collected samples indicate the relative amount of available nitrogen and a continuing supply of available phosphorus. (Gerhold-Wisconsin)
W70-05091

MEASUREMENT AND DETECTION OF EUTROPHICATION,
Central Coastal Regional Water Quality Control Board, San Luis Obispo, Calif.
For primary bibliographic entry see Field 02L.
W70-05094

EUTROPHICATION OF A TIDAL ESTUARY,
Cornell Univ., Ithaca, N.Y. Dept. of Conservation.
For primary bibliographic entry see Field 02L.
W70-05102

FACTORS AFFECTING GROWTH OF ROOTED AQUATICS IN A RIVER,
Tennessee Valley Authority, Muscle Shoals, Ala. Environmental Biology Branch; and Washington Univ., Seattle. Dept. of Civil Engineering.
W. H. Peltier, and E. B. Welch.
Weed Science, Vol 17, No 4, p 412-416, 1969. 1 fig, 2 tab, 5 ref.

Descriptors: *Rooted aquatic plants, *Rivers, *Plant growth, Tennessee, Walls, Nutrients, Sediments, Depth, Turbidity, Light penetration, Decomposing organic matter, Dissolved oxygen, Industrial wastes, Ammonia, Temperature, Phosphorus, Nitrogen, Biomass, Sands, Sago pondweed, Nitrates, Phosphates, Productivity, Distribution, Plant tissues, Growth rates, Velocity, Light quality, Rainfall, Solar radiation, Flood control, Dams.
Identifiers: Holston River (Tenn), Skimmer, Tennessee Valley Authority, Elodea, Potamogeton pectinatus, Potamogeton crispus, Heteranthera dubia Jacq, Vallisneria americana Michx, Nutrient loads, Critical levels, Area, Substrate.

Plant masses dislodge and float downstream, clogging the water intake skimmer wall at the Tennessee Valley Authority's steam plant. These aquatic plants also contribute significant amounts of decomposing organic matter causing serious reduction of dissolved oxygen; low dissolved oxygen levels in a downstream reservoir may be partially due to this transported organic matter. During 1967 field studies on the Holston River, Tennessee, and in the laboratory, evidenced that excessive aquatic plant growths are not solely related to the presence of large amounts of nutrients. Factors contributing to growth were the amount of nutrients in sediments, water depth, and turbidity. Water depth and turbidity influence the amount of light which penetrates the water and is available for rooted plant growth. The aquatic plant studied was sago pondweed (Potamogeton pectinatus L), the dominant plant in the upper Holston River. Experimental work is needed to separate the relative importance of light, sediment composition, and temperature on the growth of these nuisance aquatic plants if ecological control methods are to be determined. Unavailability of data comparing annual plant growth in relation to hydrographic and climatic conditions compounds the problem. (Jones-Wisconsin)
W70-05105

REPORT UPON THE CAUSE OF OFFENSIVE ODORS FROM LAKE MONONA, MADISON, WISCONSIN,
Alvord, Burdick and Howson, Chicago, Ill.
For primary bibliographic entry see Field 02H.
W70-05107

GLUCOSE AND ACETATE IN FRESHWATER: CONCENTRATIONS AND TURNOVER RATES,
North Carolina State Univ., Raleigh. Dept. of Zoology.
John E. Hobbie.
Proceedings of International Biological Program symposium held in Amsterdam and Nieuwersluis, October 10-16, 1966. Chemical Environment in the Aquatic Habitat, Golterman, H L and Clymo, R S, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, 1967. p 245-251, 5 fig, 9 ref.

Descriptors: *Chemical analysis, Organic matter, Water pollution effects, Analytical techniques, Kinetics, Aquatic bacteria, Algae, Physiological ecology, Carbon radioisotopes, Lakes, Phytoplankton, Bioassays.
Identifiers: *Glucose, *Acetate, *Freshwater environments, *Turnover rates, *Heterotrophy, Organic solutes, Sweden, Lake Erken (Sweden), Annual cycles, Microbial ecology, Radiocarbon uptake techniques, Michaelis-Menten equation, Relative heterotrophic potential, Lineweaver-Burk equation, Uptake velocity, Maximum uptake velocity, Substrate concentrations.

Organic solutes in the hydrosphere are extremely diverse, and their dynamic properties have greater ecological significance than do their instantaneous concentrations. Useful information regarding heterotrophic potential of lacustrine bacteria can be derived from analysis, according to enzyme-type kinetics originally proposed by Michaelis and Menten, of their uptake of radiocarbon-labeled substrates. Such treatment yields estimates of uptake velocity; maximum uptake velocity (V); turnover time (T); and relative measure (K + S) of concentrations of naturally-occurring substrates concentration (S), where K is analogous to Michaelis-Menten constant. These kinetic parameters, followed over one annual cycle, are described for glucose and acetate in Lake Erken, Sweden. V, varying 40-fold, followed algal cycles closely, peaking in June and September. That constant removal and supply of both compounds are in balance, and that they do not accumulate is indicated by seasonally constant value for (K + S), naturally-occurring concentrations (in micrograms/liter) remaining at approximately 6 for glucose, and 10 for acetate. T varied from 10 hours (summer) to approximately 1000 hours (winter). When T = 10, sizeable fraction of naturally-occurring dissolved organic carbon in lake is cycled, illustrating ecological value of knowing T as compared with knowing S. (See W70-04821 thru W70-04823). (Eichhorn-Wisconsin)
W70-05109

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1942 TO JULY 1943,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02H.
W70-05112

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1943 TO JULY 1944,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02H.
W70-05113

PHOSPHORUS CONCENTRATIONS IN THE PAMLICO RIVER ESTUARY OF NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
John E. Hobbie.
Available from the Clearinghouse as PB-190 441, $3.00 in paper copy, $0.65 in microfiche. Completion Report, North Carolina Water Resources Research Institute, Report No. 33, March 16, 1970. 47 p, 9 tab, 15 fig, 9 ref. OWRR Project B-004-NC.

Descriptors: *Estuaries, *Eutrophication, *Nutrients, *Phosphorus, Phosphates, Water pollution sources.
Identifiers: *Pamlico River, *North Carolina.

The Pamlico River of North Carolina is a naturally rich estuary of shallow depth and six inch lunar tide. The natural levels of phosphorus are 0.031 - 0.062 mg/l. As a result of phosphate mining levels as high as 2.9 mg/l have been measured. This report summarizes data collected bi-weekly since 1967. The conclusions are: (1) The Texas Gulf Sulphur Company is adding large amounts of phosphorus to the waters of the Pamlico River. This phosphorus is entering from the plant site and not from the decant water of the slimes-settling basin. (2) The phosphorus added by the phosphate mining and fertilizer manufacturing operation does not appear to be changing the ecology of the River because more than enough phosphorus for normal algal photosynthesis is already present. (3) Phosphorus concentrations in the Tar River entering the upper estuary have tripled since 1967. This is likely due to sewage and indicates that nitrogen compounds are also increasing (unpublished evidence bears this out). (4) Phosphorus concentrations are already above the 0.04 mg P/l (2.8 ug-at P/l) level that marks the limit between polluted and unpolluted waters. If sufficient nitrogen compounds become available from sewage or farm land drainage, then intense eutrophication and eventually pollution of this estuary will result within the next two decades.
W70-05115

CHEMICAL AND THERMAL CHARACTERISTICS OF KEYSTONE RESERVOIR,
Oklahoma Water Resources Research Inst., Stillwater.
For primary bibliographic entry see Field 02H.
W70-05121

MINE DRAINAGE IN THE NORTH BRANCH POTOMAC RIVER BASIN,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
Leo J. Clark.
Chesapeake Technical Support Laboratory Technical Report No 13, Federal Water Pollution Control Admin, Middle Atlantic Reg, August 1969. 87 p, 29 fig, 9 tab, 15 ref, append.

Descriptors: *Acid mine water, *Water pollution effects, *Water pollution treatment, *West Virginia, *Maryland, Costs, Economics, Water quality, Data collections, Hydrologic data, Water chemistry, Acidic water, Aquatic habitats, Mine acids, Coal mine wastes, Strip mine wastes, Waste water (Pollution).
Identifiers: Potomac River.

Water quality and mine drainage pollution of the North Branch Potomac River are surveyed. For over a century, mine drainage has been the primary cause of degradation in the basin. More than 40 miles of the main stem above Luke, Maryland, and over 100 miles of tributary streams are now virtually devoid of aquatic life because of the effects of mine drainage. The principal constituents of mine drainage are total dissolved and suspended solids, acid, iron and manganese, and toxic precipitates. An estimated 79,000 lbs/day of acidity is contributed by streams within the State of West Virginia and 39,000 lbs/day by streams within the State of Maryland. Active coal mines in West Vir-

ginia appear to be a significant, and perhaps the largest, source of acid mine drainage while in Maryland, drainage from inactive mines appears to be the most significant source. A preliminary estimate of annual expenditures required to provide necessary prevention, collection, and treatment measures in the seven most critical watersheds of the Potomac basin is $5,000,000. Capital costs are estimated at $32,500,000. (Knapp-USGS)
W70-05176

THE MODIFICATION OF PLANET EARTH BY MAN,
California Univ., Santa Barbara.
Gordon J. F. MacDonald.
Technol Rev, p 27-35, Oct/Nov 1969. 9 p, 3 fig.

Descriptors: *Environment, *Environmental effects, Air pollution, *Air pollution effects, Atmospheric pollution, Climates, Climatology, Albedo, *Earthquakes, Hazards, Heat balance, Carbon dioxide, Disasters, Oceans, Solar radiation, *Earth (Planet), Injection wells.
Identifiers: *Climatic changes, Atmospheric dust, Earthquake theory.

Man's technology is changing his physical environment in ways that are not clearly understood, endangering man's future on earth. Two major problems discussed are: how man is changing the climate and how he is producing earthquakes. The climate could be altered by carbon dioxide, aerosols, dust, changing the albedo of the earth's surface, and altering the transfer of momentum and heat between the ocean and atmosphere by oil spills. The seismic activity associated with the waste injection well near Denver, Colo., and the impounding water at Hoover, Kariba, and Koyna Dams are discussed. The large-scale lowering of groundwater table and underground nuclear explosions may also have effects on seismic activity. Evidence indicates that great earthquakes consist of a superposition of lower magnitude earthquakes. The man-made disturbances are approaching the critical magnitude range that could start a sequence of events producing a catastrophic earthquake. (USBR)
W70-05249

A LIMNOLOGICAL INVESTIGATION OF WATER QUALITY CONDITIONS IN LAKE SAMMAMISH,
Seattle Metropolitan Municipality, Wash.
Gary W. Issac, Robert I. Matsuda, and John R. Welker.
February 1966. 47 p, 16 fig, 9 tab, 11 ref.

Descriptors: *Lake morphology, *Eutrophication, *Ecology, *Limnology, *Biocontrol, Lakes, Nutrients, Chemical analysis, Sampling, Monitoring, Water quality, Water pollution effects, Pollution abatement.
Identifiers: *Lake Sammamish, *Metropolitan Seattle, *Municipality of Metropolitan Seattle, Seattle, Lake Washington.

This report is a detailed account of a morphological investigation of the water quality of Lake Sammamish, conducted in the 18 month period ending December, 1965. The Lake is situated outside of the present eastern boundary of Metropolitan Seattle (Metro). Its outlet, the Sammamish River, flows generally within Metro's boundary and discharges into Lake Washington. Metro's program of constructing facilities to remove sewage inputs to Lake Washington is nearly completed. Therefore, to permit the tributary lake to continue its pollution of Lake Washington would be contrary to all previous efforts. Twelve physical, chemical and biological monitoring stations were established throughout Lake Sammamish to collect information on temperature, transparency, nutrients, dissolved oxygen, phytoplankton and zooplankton populations, primary productivity and bacteriological analysis necessary for an accurate evaluation of the present lake conditions. It was concluded that Lake Sammamish is in a more advanced state of eutrophication than was Lake Washington in 1950, and that steps should be taken to reduce nutrient contributions and provide sewerage systems to convey the sewage away from the Lake for treatment and disposal. (Poertner-Chicago)
W70-05256

THE EFFECT OF LIGHT ON NITRATE AND NITRITE ASSIMILATION BY CHLORELLA AND ANKISTRODESMUS,
University Coll., London (England). Dept. of Botany.
For primary bibliographic entry see Field 02K.
W70-05261

THE CONTROL OF ESTUARINE POLLUTION,
Forth River Purification Board, Langgarth (Scotland).
For primary bibliographic entry see Field 02L.
W70-05262

SUMMARY OF LITERATURE ON AQUATIC WEED CONTROL,
Toronto Univ. (Ontario).
J. Murray Speirs.
Canadian Fish Culturist, Vol 3, No 4, p 20-32, 1948. 55 ref.

Descriptors: *Aquatic weed control, *Bibliographies, Cattails, Bulrush, Dredging, Copper sulphate, Pondweeds, Sodium arsenite, Fish, Animals, Algae, Cutting management, Potable water, Herbicides, Chara, Alkalinity, Bullheads, Eels, Killifishes, Trout, Suckers, Bass, Water hyacinth, Frogs, Crayfish, Mosquitoes, Bacteria, Irrigation, Willow trees, Fertilizers, Burning.
Identifiers: *Literature, Eleocharis, 2,4-D, Ammate, Chloramine, De-K-Pruf-21, Benoclors, Nigrosine dye, Sodium chlorate, Santobrite, Cladophora, Potamogeton spp, Lake Mendota (Wis), Anacharis, Naias, Scirpus, Nymphaea, Crassipes eichornia, Typha, Brasenia, Dow contact, Sparganium, Salix, Growth regulators, Myriophyllum, Water blooms, Chaining.

Several methods are available to control particular aquatics. To control emergent aquatics such as cattails, bulrushes and spikerushes, 2,4-D or ammate are effective for permanent control; dredging and use of a flame thrower are adequate temporary controls. To control algae, copper sulphate appears to be efficient; chloramine may be equally useful but requires additional testing; for algae coating concrete or wooden walls of fish tanks or reservoirs, De-K-Pruf-21 is suggested. The most effective control for pondweeds appears to be sodium arsenite but caution must be exercised where the water might be a drinking supply for mammals (including man). Benoclors are effective controls where fish and other aquatic animals are unimportant; nigrosine dye may be used to shade out the pondweeds where the black color given the water is acceptable; in some waters, pondweeds have been controlled by adding enough fertilizer to produce a water bloom shading out the pondweeds; this method may have merit where dense algal growths are preferable to pondweed growths. Water lilies are particularly resistant to chemical control methods, and persistent cutting appears the only satisfactory method. (Jones-Wisconsin)
W70-05263

THE ECOLOGY OF A RESERVOIR,
Paul A. Erickson, and John T. Reynolds.
Natural History, p 48-53, November 1969. 4 fig.

Descriptors: *Water quality control, *Ecology, *Reservoir, Massachusetts, Potable water, Water pollution, Bacteria, Algae, Nutrients, Indicators, Odor, Taste, Filters, Water treatment, Dissolved oxygen, Eutrophication, Fish, Land, Value, Leaves, Fertilizers, Pesticides, Cellulose, Cycles, Harvesting, Dredging, Monitoring, Microbiology, Food chains.
Identifiers: Quabbin Reservoir (Mass), Boston (Mass).

Techniques designed to slow the eutrophication process are: reduction of nutrients by controling sewage waste disposal, and chemical fertilizers possibly leaching into the watershed, and by bacterial decomposition of bottom sediments; by mechanical harvesting of algal populations, rooted and blossoming plants; dredging; removal of dissolved nutrients by physical and chemical agents; removal of algal populations by chemical agents and reduction by increasing fish populations. The financial and physical problems associated with their actual application are immense, as a reservoir is the focus of socio-political factors which must be weighed in any procedure. Another possibility for slowing down eutrophication lies in the unique studies, classified as 'microbial intervention.' If the reservoir ecosystem could be managed to favor bacteria groups that already compete with algae for decomposed organic nutrients, the algal food chain would be broken and algal populations of undesirable proportions could not occur, thus maximizing the reservoir's self-cleansing capability. Microbial intervention would tend to soothe the political and social pulse, for it is a 'natural process.' Precise information describing interactions of algal and bacterial populations must be understood before they can be manipulated for human benefits. (Jones-Wisconsin)
W70-05264

HALF-SATURATION CONSTANTS FOR UPTAKE OF NITRATE AND AMMONIUM BY MARINE PHYTOPLANKTON,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
Richard W. Eppley, Jane N. Rogers, and James J. McCarthy.
Limnology and Oceanography, Vol 14, No 6, p 912-920, 1969. 5 fig, 2 tab, 33 ref.

Descriptors: *Phytoplankton, *Marine microorganisms, *Nitrates, *Ammonium compounds, *Absorption, Water pollution effects, Nutrients, Kinetics, Physiological ecology, Growth rates, Dinoflagellates, Diatoms, Environmental effects, Cycling nutrients, Oligotrophy, Eutrophication, Regression analysis, Chemical analysis, Chlorophyta, Chrysophyta, California.
Identifiers: *Half-saturation constants, Rhizosolenia stolterfothii, Coccolithus huxleyi, Leptocylindrus danicus, Gonyaulax polyedra, Rhizosolenia robusta, Ditylum brightwellii, Skeletonema costatum, Chaetoceros gracilis, Cell size, Cyclotella nana, Microbial ecology, Coscinodiscus lineatus, Coscinodiscus wailesii, Asterionella japonica, Biological oceanography, Gymnodinium splendens, Monochrysis lutheri, Isochrysis galbana, Dunaliella tertiolecta, Michaelis-Menten equation, Nutrient limited growth, Irradiance, Temperature effects, Coccolithophores.

Sensitive pre- and post-incubation analyses for nitrate and ammonium permitted determination of uptake rate (v) as a function of ambient concentration (S) of these nutrients for nitrogen-depleted cells of 16 species of laboratory-cultured marine phytoplankters, including diatoms, coccolithophores, dinoflagellates, chrysophytes, and chlorophytes. Graphic plots of v versus S yielded hyperbolic relationships, kinetic analysis of which gives estimates of half-saturation constants (K-sub-s, that concentration supporting half-maximum v) having ecological significance as they reflect relative ability of organisms to utilize nutrients present in low concentrations. K-sub-s, so determined, were generally similar for both nutrients, with oceanic species demonstrating lowest values. Approximately, K-sub-s varies proportionately with cell size and inversely with specific growth rate, varying between 0.1 (Coccolithus huxleyi, an oceanic species) and 10.3 (Gonyaulax polyedra, a neritic dinoflagellate, for nitrate). Confidence limits (95%) are presented for determinations of the constant. For four species--where data exists relating specific growth rate (Mu) to irradiance temperature, and day length-- variation in Mu with ambient nitrate and ammonium concentrations can be calculated, thus permitting useful ecological

predictions regarding interspecific competition in terms of those environmental characteristics. (Eichhorn-Wisconsin)
W70-05265

A NUMERICAL MODEL FOR THE ESTIMATION OF PHOTOSYNTHETIC PRODUCTION, INTEGRATED OVER TIME AND DEPTH, IN NATURAL WATERS,
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.
Everett J. Fee.
Limnology and Oceanography, Vol 14, No 6, p 906-911, 1969. 2 fig, 9 ref.

Descriptors: *Mathematical models, *Estimating equations, *Numerical analysis, *Photosynthesis, *Primary productivity, *Aquatic environments, Analytical techniques, Water pollution effects, Systems analysis, Digital computers, Light intensity, Lakes, Light penetration, Optical properties, Phytoplankton.
Identifiers: *Temporal variation, *Depth variation, *Integration, Vollenweider's photosynthesis model, Photoinhibition, Photobiology, Trophic biology, Irradiance, Empirical data, Extinction coefficient.

Integration over time and depth of photosynthetic rates (P) is complicated by inhibition of photosynthesis at high light levels. In absence of photoinhibition, P asymptotically approaches upper limiting value (P-max) with increasing irradiance (I). An available model (Vollenweider's) accounts for photoinhibition by relating relative photosynthesis (= ratio, P/P-max) to relative light intensity (= ratio, I/I-sub-k) in equation with two empirical parameters (a, n), where I-sub-k is saturating light intensity, defined by assuming linear approach of P to P-max. Model is illustrated with figures of families of curves for arbitrarily selected values of a and n. Vollenweider achieved exact solution of depth integral by fixing values of a and n, and assuming cosine distribution of daily irradiance, but failed to identify appropriate solutions for particular data sets relating P to I. Method reported here achieves generality, employing two computer programs to estimaters model parameters and solve double integral. Data required are: depth distribution of P; short-term P at optimal I; extinction coefficient of water column; temporal measurements of surface irradiance, usually over course of a day. Solution is considered biologically inadequate in sense that it fails to consider variations in photosynthetic parameters and in phytoplankton distributions with depth and time. (Eichhorn-Wisconsin)
W70-05266

ON THE BIOLOGICAL SIGNIFICANCE OF PHOSPHATE ANALYSIS; COMPARISON OF STANDARD AND NEW METHODS WITH A BIOASSAY,
Minnesota Univ., Minneapolis. Limnological Research Center.
William Chamberlain, and Joseph Shapiro.
Limnology and Oceanography, Vol 14, No 6, p 921-927, 1969. 2 fig, 2 tab, 13 ref.

Descriptors: *Water chemistry, *Water pollution effects, *Phosphates, *Analytical techniques, *Bioassays, Organophosphorus compounds, Solvent extractions, Phosphorus compounds, Lakes, Sewage effluents, Arsenic compounds, Spectrophotometry, Algae, Minnesota, Sodium arsenite.
Identifiers: Arsenate interference, Dissolved inorganic phosphates, Soluble reactive phosphorus, Phosphate (Biologically available), Microcystis aeruginosa, Lake Como (Minn), Lake Vadnais (Minn), Mille Lac (Minn), Deming Lake (Minn), Orchard Lake (Minn), Lake Owasso (Minn), Lake Josephine (Minn), Gray's Bay (Minn), Smith's Bay (Minn), Phosphate determination methods.

The possibility exists that standard analytical methods might overestimate dissolved inorganic phosphate, thus modified techniques have been introduced to operate an operationally defined fraction of phosphorus compound, 'soluble reactive phosphorus.' Availability of various analytical procedures raises the question of which one measures the phosphorus fraction which is important as a plant nutrient. Two sewage effluents and water from 11 Minnesota lakes were analyzed by four procedures: Harvey method, 6-second method, solvent extraction, Stephens method. Analytical results were compared with magnitude of phosphate uptake during a bioassay employing phosphorus-starved cells of blue-green alga, Microcystis aeruginosa. Waters could be arranged into two groups based upon magnitude of difference between results of Harvey method and extraction procedure. Waters of group II, where such differences were large, all were high in arsenate (16-56 micrograms arsenate-arsenic/liter), arsenate interference from such concentrations being sufficiently large to account for discrepancies in phosphate determinations. Extraction procedure is less sensitive to arsenate interference than are other methods. In analyzing lake water for phosphates, it is advisable to assume that arsenic is present. Phosphate analyses resulting from extraction procedure were in good agreement with biologically available phosphates as determined by bioassay. (Eichhorn-Wisconsin)
W70-05269

AMINO ACID FLUX IN AN ESTUARY,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 02L.
W70-05271

DDT REDUCES PHOTOSYNTHESIS BY MARINE PHYTOPLANKTON,
State Univ. of New York, Stony Brook. Dept. of Electrical Engineering.
Charles F. Wurster, Jr.
Science, Vol 159, p 1474-1475, March 1968. 2 fig, 21 ref.

Descriptors: *Water pollution effects, *Photosynthesis, *Phytoplankton, *DDT, *Marine algae, Toxicity, Diatoms, Estuaries, Physiological ecology, Massachusetts, Chlorophyta, Dinoflagellates, Algae, California, Florida, Pesticide residues, Ecosystems, Food chains, Biological communities, Bioassays, Eutrophication.
Identifiers: Skeletonema costatum, Coccolithus huxleyi, Pyramimonas, Peridinium trochoideum, Vineyard Sound (Mass), Woods Hole (Mass). Radiocarbon uptake techniques, Microbial ecology, Coccolithophores, Seawater medium f.

Widely distributed in the hydrosphere, the insecticide DDT has potentially great and diverse ecological effects. Little is known about its influence on phytoplankton. Over range of concentrations 1-500 ppb, its effect on photosynthesis, under controlled conditions of light and temperature, was determined for a natural population of phytoplankton and for four species of laboratory cultured marine phytoplankters: Skeletonema costatum (diatom), Coccolithus huxleyi (coccolithophore), Pyramimonas (green alga), Peridinium trochoideum (dinoflagellate). When photosynthesis (measured as percentage of radiocarbon uptake by untreated controls) is plotted against increasing dosage of DDT, characteristic sigmoid curves result, with photosynthesis decreasing approximately linearly in dosage range 1-100 ppb DDT. Sigmoid dose-response curves apparently indicate absence of threshold levels below which no effects occur. Testing relationship in Skeletonema between cell concentrations and toxicity revealed that photosynthesis diminished to 50% of controls when final cellular concentrations were reduced 100-fold. For chemical reasons, effective doses of DDT in these experiments may be lower than quantities added initially. Moreover, because DDT becomes available naturally at steady rates, given concentration in nature would have greater ecological significance than same initial experimental concentration. Selective toxic stress by DDT may create floral imbalance, thereby aggravating less desirable manifestation of eutrophication. (Eichhorn-Wisconsin)
W70-05272

EFFECTS OF THERMAL STRATIFICATION AND NUTRIENT AVAILABILITY ON THE PRODUCTIVITY OF RESERVOIR PHYTOPLANKTON,
Tennessee Valley Authority, Chattanooga. Biology Section.
Mahlon P. Taylor, and Eugene B. Welch.
Tennessee Valley Authority, Div of Health and Safety, Water Quality Branch, Chattanooga, Mimeo, May 1968. 36 p. 9 fig, 4 tab, 19 ref.

Descriptors: *Productivity, *Phytoplankton, *Fertilization, Nitrogen, Phosphorus, Thermal stratification, Analytical techniques, Epilimnion.
Identifiers: Clinch River (Tenn), Carbon-14 techniques, Fertilizer loss, Norris Reservoir (Tenn), Tennessee Valley Authority, Mono-ammonium phosphate, Ammonium sulfate, Chlorophyll a, Photic zone.

Six coves on Norris Reservoir on the Clinch River, Tennessee, were fertilized at 2-week intervals with mono-ammonium phosphate and ammonium sulfate, mixed in 16-20-0 ratio. The primary phytoplankton production was determined by carbon-14 technique. Other determinations included chlorophyll a, total phosphorus, forms of nitrogen, total inorganic carbon, and photic depth. Under the influence of thermal stratification and reduction of phosphorus content in the epilimnion, productivity declined in May and remained low until September. The fall increase in the epilimnetic phosphorus content induced accelerated productivity. Applied fertilizer sank from the epilimnion in less than 6 hours and the difference between the average productivity of control and fertilized coves was not statistically significant at 95% confidence level. (Wilde-Wisconsin)
W70-05274

POLUTION AND POVERTY: THE STRATEGY OF CROSS-COMMITMENT,
Roger Starr, and James Carlson.
The Public Interest, NO. 10, Winter 1968, p 104-131. 28pp, 6 ref.

Descriptors: *Water pollution, Pollution abatement, Governments, Biochemical oxygen demand.
Identifiers: *Poverty.

The fight against pollution is charged with emotional enthusiasm that may reverse itself when the public discovers that many now polluted waters cannot be fully restored, and that many expenditures of anti-pollution funds will have been to no avail. The question of how to define clean water is raised. The use of biochemical oxygen demand as a measure of organic pollution is examined. The problems developed are: who should have responsibility for what actions, and what local interests and national needs must be reconciled. Three sources of pollution are given: agricultural activity, industrial plants large enough to discharge their effluents directly into waterways, and rainfall. Each source is examined as to the possibilities of preventing pollution. Problems of technology and costs of treating sewage and developing sewers are discussed. The cross-commitment of the public to stopping pollution and stopping poverty (through housing, jobs, education and income supplements) has resulted in competition for funds. (Grossman-Rutgers)
W70-05285

THE EFFECT OF DELETERIOUS CONCENTRATIONS OF COPPER ON THE PHOTOSYNTHESIS OF CHLORELLA PYRENOIDOSA,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
For primary bibliographic entry see Field 02K.

W70-05370

REPORT OF THE COMMITTEE ON TERMS AND EQUIVALENTS,
International Council for the Exploration of the Seas, Charlottenlund (Denmark).
For primary bibliographic entry see Field 07C.
W70-05371

THE RELATIONSHIP OF FRESH-WATER PROTOZOAN COMMUNITIES TO THE MACARTHUR-WILSON EQUILIBRIUM MODEL,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology; Virginia Polytechnic Inst., Blacksburg. Dept of Forestry and Wildlife; and Michigan Univ., Ann Arbor. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W70-05374

DISTRIBUTION AND ABUNDANCE OF PHYTOPLANKTON AND ROTIFERS IN A MAIN STEM MISSOURI RIVER RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
For primary bibliographic entry see Field 02H.
W70-05375

THE PHYSICAL-CHEMICAL LIMNOLOGY OF A NEW RESERVOIR (BEAVER) AND A FOURTEEN YEAR OLD RESERVOIR (BULL SHOALS) LOCATED ON THE WHITE RIVER, ARKANSAS AND MISSOURI,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
For primary bibliographic entry see Field 02H.
W70-05380

THE ADAPTATION OF PLANKTON ALGAE. IV. LIGHT ADAPTATION IN DIFFERENT ALGAL SPECIES,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
For primary bibliographic entry see Field 02K.
W70-05381

BIOLOGICAL EFFECTS OF INDUSTRIAL DEFILEMENTS IN THE RIVER BILLEBERGAAN,
Lund Univ. (Sweden). Limnological Inst.
Ingemar Sorensen.
Acta Limnologica (Sweden), 1948. 73 p, 17 fig, 5 tab, 41 ref, appendix.

Descriptors: *Rivers, *Water pollution effects, *Water pollution sources, Industrial wastes, Fishkill, Self-purification, Fish diseases, Chlorine, Fungi, Microorganisms, Fish, Diatoms, Populations, Physicochemical properties, Analysis, Ammonium compounds.
Identifiers: *Billebergaan River (Sweden), Sweden, Potassium cyanide, Laundry wastes, Ammonium hydroxide.

This contribution to the knowledge of water pollution reports fish poisoning and other biological injuries caused by a discharge of cleaning and laundry chemicals. The first fishkill was followed a week later by another mortality caused by an attack of fungi on specimens weakened by chemicals. The microzoan population was largely destroyed and was not regenerated for several weeks. The microphyte population has undergone considerable change in its composition, characterized by a great increase in diatoms. The effect of pollution was expressed in marked increase of the downstream water in potassium, magnesium, oxygen and especially in oxygen demand and biochemical oxygen demand. A supplemental tabular record of some 300 species of microphyta and microzoa inhabiting rivers is included; the organisms are classified into four divisions in accordance with their frequency of occurrence. (Wilde-Wisconsin)
W70-05385

ALGAE AND PHOTOSYNTHESIS IN SHAGAWA LAKE, MINNESOTA,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 02H.
W70-05387

MEASUREMENTS OF EUTROPHICATION AND TRENDS,
Wisconsin Univ., Madison. Water Resources Center.
E. Gus Fruh, Kenton M. Stewart, G. Fred Lee, and Gerard A. Rohlich.
Journal of the Water Pollution Control Federation, Vol 38, No 8, p 1237-1258, 1966. 8 fig, 4 tab, 116 ref.

Descriptors: *Measurement, *Eutrophication, *Biomass, *Primary productivity, *Wind pressure, Lakes, Sampling, Biological properties, On-site investigation, Phytoplankton, Zooplankton, Chlorophyll, Transparency, Nutrient requirements, Oxygen, Nitrogen, Phosphorus, Chlorine, Sulfates, Toxicity, Epilimnion, Benthos, Hypolimnion, Analytical techniques, Cores, Stratification, Thermocline, Water pollution treatment, Waste water, Zoning, Water quality, Manpower.
Identifiers: Eutrophication rate, Specific conductance, Carbon-14 analysis, Suspended solids, Desirable trends, Surveillance.

A survey of data pertinent to living and abiotic constituents of lake waters revealed that an appraisal of the state and the rate of water eutrophication demands a diversity of periodic physical, chemical, and biological measurements. Such analyses must embrace a number of sampling sites exposed to different environmental conditions and anthropogenic influences. The sampling should be adequate and frequent enough to provide a statistically significant record of the spacial and temporal dynamics of water basins. The preferred biological analyses include areal or volumetric measurements of algal stands, determination of chlorophyll and primary productivity, regression in depth of rooted aquatics, biomass and nature of zooplankton, occasionally including benthic fauna and fish. Of no lesser importance are analyses of sediment cores, the epilimnion-hypolimnion ratio, the rate of oxygen consumption, biochemical oxidation of reduced compounds, water transparency, and nutrient budgets, not necessarily limited to those of nitrogen and phosphorus. Particular attention must be given to the contributions of nutrients and toxic substances delivered to the basin by natural, agricultural, and urban drainage, as well as by wastewater effluents. (Wilde-Wisconsin)
W70-05394

THE TURNOVER RATIO IN PRODUCTION ECOLOGY OF FRESHWATER INVERTEBRATES,
Minnesota Univ., St Paul. Dept. of Entomology, Fisheries, and Wildlife.
For primary bibliographic entry see Field 07B.
W70-05396

ON THE THEORY OF ADDING NUTRIENTS TO LAKES WITH THE OBJECT OF INCREASING TROUT PRODUCTION,
Dalhousie Univ., Halifax (Nova Scotia). Zoological Lab.
For primary bibliographic entry see Field 02H.
W70-05399

LIMNOLOGICAL RELATIONS OF INDIAN INLAND WATERS WITH SPECIAL REFERENCE TO WATERBLOOMS,
University Coll., London (England). Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-05404

THE EUTROPHICATION OF LAKE KLOPEINER (In German),
Biologische Station Lunz (Austria).
For primary bibliographic entry see Field 02H.
W70-05405

ENVIRONMENTAL REQUIREMENTS OF FRESH-WATER PLANKTON ALGAE,
Uppsala Univ. (Sweden). Inst. for Physiological Botany.
For primary bibliographic entry see Field 02H.
W70-05409

NUTRIENT REMOVAL A UNIVERSAL REQUIREMENT,
For primary bibliographic entry see Field 02H.
W70-05412

THE AGING GREAT LAKES,
For primary bibliographic entry see Field 02H.
W70-05415

THE PHYTOPLANKTON OF SOME IRISH LOUGHS AND AN ASSESSMENT OF THEIR TROPHIC STATUS,
Bristol Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-05416

PHOSPHATE FERTILIZATION OF PONDS,
Alabama Agricultural Experiment Station, Auburn.
For primary bibliographic entry see Field 02H.
W70-05417

MODELS FOR DESCRIBING EXCHANGES WITHIN ECOSYSTEMS,
Wisconsin Univ., Madison. Inst. for Environmental Studies.
For primary bibliographic entry see Field 06A.
W70-05420

EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES,
Ontario Water Resources Commission, Toronto.
M. G. Johnson, M. F. P. Michalski, and A. E. Christie.
Ontario Water Resources Commission, Division of Research - Publication No 30, 1969. 41 p, 5 tab, 6 fig, 15 ref, 3 append.

Descriptors: *Acid mine water, Acidic water, Hydrogen ion concentration, Water chemistry, *Phytoplankton, Carbon dioxide, Nutrient requirements, Populations, Environmental effects, *Primary productivity, Water pollution effects, Bioassays, Algae, Comparative productivity, Aquatic productivity, Distribution, Species diversity.
Identifiers: Ontario lakes, Quirke Lake, Pecors Lake, Dunlop Lake, *Inorganic carbon.

Studies were carried out on three Northern Ontario lakes; two (Quirke and Pecors Lakes) were contaminated by free mineral acidity and one (Dunlop Lake) was unaffected. Lower phytoplankton populations and indices of diversity were found in Quirke and Pecors Lakes than in Dunlop Lake. Many species of Bacillariophyceae, Chrysophyceae and Myxophyceae developed in the reference lake but were absent or occurred in extremely low numbers in the contaminated lakes. Average primary productivities in Dunlop, Quirke and Pecors Lakes were 126, 71 and 34 mg C m- (2) day- (1), respectively. In situ areal and volumetric measurements in laboratory and field bioassays confirmed the importance of inorganic carbon in limiting primary productivity. It is concluded that inorganic carbon limits primary productivity in the lakes contaminated by acid mine wastes, with the reduced pH and inorganic carbon decreasing both the number of species and total number of phytoplankton. (Sjolseth and Katz-Washington)
W70-05424

CHLORINATED BIPHENYLS IN FISH, MUSSELS AND BIRDS FROM THE RIVER RHINE AND THE NETHERLANDS COASTAL AREA,
Utrecht Rijksuniversiteit (Netherlands). Inst. of Veterinary Pharmacology and Biological Toxicology.
For primary bibliographic entry see Field 05A.
W70-05425

PESTICIDES AND THE WESTERN GREBE - A STUDY OF PESTICIDE SURVIVAL AND TROPHIC CONCENTRATION AT CLEAR LAKE, LAKE COUNTY, CALIFORNIA,
Rochester Univ., N.Y. Dept. of Radiation Biology and Biophysics.
S. G. Herman, R. L. Garrett, and R. L. Rudd.
Chemical Fallout - Current Research on Persistent Pesticides, Chapter II, p 24-53, 1969. 8 tab, 7 fig, 17 ref.

Descriptors: Water birds, *DOT, Trophic level, *Pesticide residues, *Pesticide toxicity, Chlorinated hydrocarbon pesticides, Mortality, Pesticide kinetics, Reproduction, Gas chromatography, Distribution.
Identifiers: *Clear Lake (Calif), *Western Grebe, Aechmophorus occidentalis, *Trophic concentration, DDD, DDE, Reproductive success, Reproductive inhibition.

The Clear Lake, California ecosystem contains chlorinated hydrocarbon residues, chiefly of the DDT series. The effects of trophic concentration are most obvious in the Western grebe, a fish-eating bird, in which both acute mortality and reproductive inhibition, presumably attributable to high residue loads, have combined to cause population declines. This report centers on probably pathways of residue transfer and on the precise manner in which reproduction might be affected. Various aspects of the population biology of the Western grebe and its prey species are described. The breeding population of this colonially nesting species is approximately 150 pairs. Regular aerial censusing shows variation in total numbers throughout the year as well as differential distribution in the lake. Residue loads in grebe tissues have remained relatively high over several years, averaging, as examples, in 1967 in DDD alone 544 ppm (wet weight) in subcutaneous fat, 296 ppm (lipid weight) in eggs, and 546 ppm (lipid weight) in the yolk sacs of hatching grebes. All fishes contain DDD and other residues. Residues in grebes vary seasonally and appear strongly correlated with feeding rates and selection of prey types. (Sjolseth and Katz-Washington)
W70-05426

THE INCREASING CHAOBORID MIDGE PROBLEM IN CALIFORNIA,
S. F. Cook, Jr.
California Vector Views, Vol. 14, No. 6, p 39-44, June 1967. 4 tables, 8 refs.

Descriptors: Limnological, *Aquatic environment, Midges, Impoundments, *Insect control, Larvae, Reservoirs, Aquatic population, Lake morphalogy, Environmental effects.
Identifiers: Clear Lake (Calif), Chaoborid midges, *Chaoborus astictopus, *Insect populations, *Seasonal population variations.

Surveys of many artificial water impoundments in California indicate that the Clear Lake 'gnat', Chaoborus astictopus (Diptera: Chaoboridae), is becoming widespread throughout the state. The abundance of these nuisance midges in many reservoirs and smaller pounds rivals the densities previously associated with Clear Lake, Lake County. Limnological data acquired on many bodies of water sampled indicate little correlation between gnat numbers and lake or pond character. In view of the statewide nuisance potential of these organisms, and the rapidly increasing shoreline development of impounded water, it is recommended that a state supported research program be initiated to study the basic aspects of chaoborid control in California. (Sjolseth and Katz-Washington)
W70-05427

THE POTENTIAL ROLE OF FISHERY MANAGEMENT IN THE REDUCTION OF CHAOBORID MIDGE POPULATIONS AND WATER QUALITY ENHANCEMENT,
For primary bibliographic entry see Field 05G.
W70-05428

SOME EFFECTS OF A NEUTRAL MIXTURE OF CALCIUM OXIDE AND SULFURIC ACID ON CHANNEL CATFISH ICTALURUS PUNCTATUS (RAFINESQUE),
Kansas Univ., Lawrence. Dept. of Zoology.
Richard E. Sparks, John Cairns, Jr., and Frank B. Cross.
Transactions of the Kansas Academy of Science, Vol 72, p 1-15, No 1, 1969. 7 tab, 1 fig, 14 ref.

Descriptors: *Lime, *Channel catfish, Water pollution effects, *Bioassay, Toxicity, Mortality, *Suspended load, Calcium sulfate, Waste disposal, Solid wastes.
Identifiers: *Calcium oxide, *Sulfuric acid, Ictalurus punctatus, Kill Creek (Kans), Ammunition plant, Gill disorders.

An Army Ammunition Plant discharges waste containing sulfuric acid neutralized with slaked lime into Kill Creek, a tributary of the Kansas River. Channel catfish, Ictalurus punctatus (Rafinesque), are indigenous to both streams. Twelve channel catfish, kept in a synthetic waste approximating that of the plant, died within two days when a suspended solids concentration of 24,200-30,400 mg/l was maintained by vigorous aeration. Ten out of 15 channel catfish survived in synthetic waste for the 22-28 day duration of the experiments when a suspended solids concentration of 367-509 mg/l was maintained by moderate aeration. Eleven of 12 catfish survived 22-28 days in synthetic waste from which all settleable solids were removed, and 17 of 22 catfish kept in tapwater as controls survived 22-28 days. The findings of this study suggest that acid treatment plants should remove settleable solids from neutralized waste before it is discharged, thereby preventing at least one potential stress on some fish in receiving streams. (Sjolseth-Washington)
W70-05429

DDT: SUBLETHAL EFFECTS ON BROOK TROUT NERVOUS SYSTEM,
Carleton Univ., Ottawa (Ontario). Dept. of Biology.
J. M. Anderson, and M. R. Peterson.
Science, Volume 164, p 440-441, April 25, 1969. 1 fig, 1 tab, 9 ref.

Descriptors: *DDT, *Brook trout, *Fish physiology, *Fish behavior, Chlorinated hydrocarbon pesticides, Acclimatization.
Identifiers: Salvelinus fontinalis, Sublethal effects, *Central nervous system, *Cold-blocking temperature, Thermal acclimation mechanism, *Avoidance responses.

When brook trout are exposed for 25 hours to sublethal doses of DDT, the cold-blocking temperature for a simple reflex, which shows lability related to thermal history, is altered in a way suggesting that DDT is affecting the thermal acclimation mechanism. Sublethal dosage of DDT also prevents the establishment of a visual conditioned avoidance response. (Sjolseth and Katz-Washington)
W70-05430

EVALUATING RISKS OF PESTICIDES TO FISH,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 05A.
W70-05431

DISTRIBUTION OF THE ABALONE (HALIOTIS MIDAE) AND THE EFFECT OF TEMPERATURE ON PRODUCTIVITY,
South African Dept. of Industries, Cape Town.
G. G. Newman.
Division of Sea Fisheries, Investigational Report No 74, 1969. 7 p, 4 fig, 2 tab, 16 ref.

Descriptors: *Water temperature, Thermal stress, Commercial shellfish, Distribution, *Distribution patterns, Aquatic productivity, Comparative productivity, Environmental effects, *Growth rates, *Shellfish.
Identifiers: South Africa, *Abalone, *Haliotis midae, Recruitment, Maximum size, Size composition.

(Haliotis midae) was recorded to a maximum depth of 75 feet along the South African coast between Qora River and St. Helena Bay. Abalone are usually aggregated rather than evenly distributed on the bottom and the geographic range could be divided into three areas in which the productivity of stocks differs. These areas have different mean annual temperatures, which are sufficient to influence the maximum size, growth rate, onset of sexual maturity and spawning intensity of abalone. Larger abalone were associated with the colder areas but in the cold area productivity was low. Differences in some of these parameters are in turn shown to contribute to the different levels of productivity recorded in the three areas. (Sjolseth-Washington)
W70-05432

DETECTION OF TOXICITY OF AFLATOXINS, STERIGMATOCYSTIN, AND OTHER FUNGAL TOXINS BY LETHAL ACTION ON ZEBRA FISH LARVAE,
Department of National Health and Welfare, Ottawa (Ontario). Food and Drug Research Lab.
Z. H. Abedi, and P. M. Scott.
Journal of the Association of Official Analytic Chemists, Vol 52, p 963-969, Sept 1969. 2 tab, 2 fig, 49 ref.

Descriptors: *Fish toxins, *Bioassay, *Toxicity, Fish kill, Mortality.
Identifiers: *Fungal toxins, *Zebra fish larvae, Brachydanio rerio, *Sterigmatocystin, Gliotoxin, Aflatoxin B2, Aflatoxin G1, Aflatoxin G2, Aflatoxin B1, Morphological effects, Stemphone.

The effects of 13 fungal toxins (and one derivative) on the larvae of zebra fish, Brachydanio rerio (Hamilton-Buchanan), were investigated. The most toxic were sterigmatocystin, gliotoxin, and aflatoxin B1, which were lethal at concentrations of less than 1 ug/ml. Aflatoxins B2, G1, and G2, stemphone, diacetoxyscirpenol, ochratoxin A, aspertoxin, and patulin also showed toxicity to the larvae, while aflatoxin B1 hemiacetal, penicillic acid, and griseofulvin were non-toxic at the levels tested. Specific morphological effects were noted with sterigmatocystin, aflatoxins, and stemphone. The usefulness of zebra fish larvae as bioassay test organisms for fungal toxins is discussed. (Sjolseth-Washington)
W70-05433

CYANIDE POLLUTION AND EMERGENCY DUTY TRAIN WRECK; DUNREITH, INDIANA; JANUARY, 1968,
Indiana State Board of Health, Indianapolis. Div. of Sanitary Engineering.
Samuel L. Moore, and Stephen R. Kin.
Purdue Univ, Engineering Bulletin No 132 (Pt 1), p 583-600, 1968. 2 ref, 2 fig, 4 append.

Descriptors: *Public health, *Fishkill, *Water pollution effects, Water quality control, Water pollution treatment, *Water pollution control, Monitoring, On-site investigations, Bioassay.
Identifiers: *Cyanide pollution, Acetone cyanohydrin, Ethylene oxice, Methyl methacrylate, Dunreith (Ind).

A train wreck resulted in the spillage of acetone cyanohydrin, vinyl chloride, ethylene oxide and methyl methacrylate and the subsequent loss of thousands of fish. The analytical tests for cyanide (phenolphthalin test) made on the receiving stream and on fish in the steam and in live boxes show that free cyanide was lethal to fish at concentrations above 0.1 mg/l, was lethal to most game fish at 0.05 to 0.1 mg/l, and to some fish at concentrations as low as 0.03 mg/l. It was found that addition of calcium hypochlorite to cyanide polluted streams converted cyanide to cyanate and thus protected the water quality. (Sjolseth-Washington)
W70-05434

CHAPTER XIII: PULP-MILL WASTE-WATER DISCHARGES INTO PUGET SOUND: AN INDUSTRY VIEWPOINT,
Northwest Pulp and Paper Association, Seattle, Wash.
For primary bibliographic entry see Field 05B.
W70-05453

MANAGEMENT OF CATTLE FEEDLOT WASTES,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 05D.
W70-05465

ALGAL GROWTH AND DECOMPOSITION: EFFECTS ON WATER QUALITY, NUTRIENT UPTAKE AND CHEMICAL COMPOSITION OF ALGAE IN BATCH CULTURE,
Kentucky Water Resources Inst., Lexington.
Edward G. Foree, and John S. Tapp, Jr.
Available from the Clearinghouse as PB-190 801, $3.00 in paper copy, $0.65 in microfiche. Research Report No. 26, Water Resources Institute, University of Kentucky, Lexington, Kentucky, March, 1970. 76 p, 6 tab, 19 fig, 43 ref. OWRR Project A-021-KY.

Descriptors: *Eutrophication, *Algae, *Nutrient requirements, Chlorophyta, Cyanophyta, Cycling nutrients, Nitrogen, Phosphorus, Chemical analysis, Proteins, Carbohydrates, Lipids.
Identifiers: *Algal growth, Nutrient uptake, Chemical composition, Algal decomposition.

The chemical composition of algae grown in batch culture depends mainly on environmental conditions, nutrient availability, presence of predators, cell age, and species. The effects of nutrient availability and cell age on the composition of three unialgal cultures (algae + bacteria) and one heterogeneous culture (algae + bacteria + microscopic animals) were evaluated. The cultures were grown in batch culture under both nutrient-abundant and nutrient-deficient conditions and the changes in compositions were observed. Luxurious uptake, where nutrients are incorporated into cellular protoplasm at levels greater than those necessary for growth, and super-luxurious uptake, where some nutrients are stored rather than converted into algal protoplasm, were observed. The commonly used model for calculating the weight percentage of protein was inaccurate when super-luxurious uptake occurred. Composition of the cultures was generally characterized by protein synthesis during the nutrient-abundant growth phase, by a fluctuating composition during transition from nutrient-abundant to nutrient-deficient growth, and by lipid and/or carbohydrate synthesis and the establishment of a relatively constant composition during the nutrient-deficient growth phase.
W70-05469

TECHNICAL APPROACHES TOWARD EVALUATING ESTUARINE POLLUTION PROBLEMS,
Public Health Service, Portland, Oreg. Div of Water Supply and Pollution Control; and Washington State Dept. of Fisheries, Brinnon. Shellfish Lab.
A. F. Bartsch, R. J. Callaway, R. A. Wagner, and C. E. Woelke.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 693-700, 1967. 8 p, 13 fig, 3 tab, 23 ref.

Descriptors: *Water pollution sources, *Water pollution control, *Estuaries, *Washington, Pulp wastes, Water quality, Salmon, Oysters, Bioassay, Analytical techniques, Salmonids, Research and development, Oceanography.
Identifiers: *Estuarine pollution.

Field investigations were undertaken to determine the effects of pulp and paper mill wastes on water quality at Everett, Bellingham, Anacortes, and Port Angeles, Washington. The research program required a coordinated effort of oceanographers, biologists, engineers, and others. Pulp and paper mill wastes occur at points where the juvenile salmonids and oysters are found. Three biological studies discussed in this paper are: (1) oyster larva bioassays for the Bellingham-Samish and Port Angeles areas; (2) adult oyster mortality, growth and conditions index for the Bellingham-Samish area; and (3) live box bioassays with juvenile solmonids for the Everett area. (Carstea-USGS)
W70-05538

BIOLOGICAL PRODUCTION AND DISTRIBUTION OF CARBON DIOXIDE IN WOODS HOLE WATERS,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 05A.
W70-05540

5D. Waste Treatment Processes

THE OPERATION OF THERMAL POWER STATIONS IN RELATION TO STREAMS,
Central Electricity Generating Board, Leatherhead (England). Biology and Effluents Section.
F. F. Ross.
Institute of Sewage Purification, January, 1959, p 16-29, 4 fig, 2 tab.

Descriptors: *Cooling water, *Dissolved oxygen, Cooling towers, *Thermal pollution, Fish, Temperature, Chlorination.
Identifiers: Bottom mud deposits, Ash disposal.

The paper is divided into three parts, small discharges, disposal of heat and results of recent research. Air used for combustion of coal or oil becomes converted to flue gas. Washing the gases to remove sulphur oxides does not benefit the atmosphere to an extent that is in any way detectable by the established methods of measuring sulphur pollution; on the other hand it necessarily contributes to the pollution of the river. Instead of using river water, a new process of gas washing under trial at Nottingham makes use of ammoniacal liquor from gas works. Condenser tubes, being slightly warmer than the water which passes through them, become coated with slime growths of bacteria and fungi. This reduces heat transfer, increases the temperature of condensation, reduces the efficiency of power generation, and increases the heat that has to be disposed of. Chlorination is nearly always the most effective remedy. It is common belief that when water is warmed, some of the dissolved oxygen is driven out of it. This can only be true if the water is saturated, and even then it may remain supersaturated until it has cooled again. BOD and U-V Tests indicate a significant reduction of total organic matter, even in one passage through the tower. For the disposal of heat, the most economical temperature rise in cooling water is 14-18 deg F; more makes the water too warm and reduces efficiency, while less means that more water has to be pumped and wastes power. A temperature of 93 deg F may be taken as upper-limit for fish. An instantaneous change of about 15 deg F will adversely affect coarse fish. (Upadhyaya-Vanderbilt)
W70-05051

A SOLUTION OF THE COTTON SIZING WASTES PROBLEM,
Hercules Powder Co., Wilmington, Del.
For primary bibliographic entry see Field 05B.
W70-05075

METABOLIC UPTAKE OF PHOSPHORUS BY WASTEWATER ORGANISMS,
Johns Hopkins Univ., Baltimore, Md. Dept. of Sanitary Engineering and Water Resources.
Gilbert V. Levin, and Joseph Shapiro.
Journal Water Pollution Control Federation, Vol 37, No 6, p 800-821, 1965. 22 fig, 3 tab, 24 ref.

Descriptors: *Waste water treatment, *Phosphorus, Metabolism, Dissolved oxygen, Uptake, Sludge treatment, Energy transfer, Aeration, Hydrogen ion concentration, Biodegradation, Sewage, Eutrophication.
Identifiers: Phosphate stripping, Sludge solids, Plant-scale studies, ATP, Carbohydration, Metophosphate, Biological oxidation.

Inorganic orthophosphate is a prerequisite for energy transfer in all living organisms. Orthophosphate enters metabolic chain of reaction when adenosine triphosphate (ATP) is created or regenerated. Phosphorus, rather than available carbon, might be limiting in biological oxidation of carbohydrates. Phosphate removal is aided by granules in bacteria, algae, and fungi storing metaphosphate. Modifying activated waste systems promotes higher phosphate removal by sludge organisms. Laboratory experiments with mixed sewage liquids indicate a greater phosphate uptake with carbohydrate added. Sludge is the active fraction of mixed liquor adsorbing orthophosphate. Aerated sludge removes greater amounts of phosphate; aeration rate determining ultimate phosphate adsorption. An optimum rate of aeration was 17 milliliter/second applied to 1500 milliliter portion of mixed fluid. Using pure oxygen instead of air increased uptake at same uptimum rate. Substantial orthophosphate leakage occurs without aeration. Optimum pH is 7-8 for phosphate removal; removal efficiency may be significantly improved by stripping phosphate from sludge by lowering pH before recycling. Practical application of metabolic uptake of phosphorus depends upon sludge organisms adsorbing more phosphate than they need for growth. Application of laboratory work to plant-size operation found increased aeration improves orthophosphate uptake. (Bannerman-Wisconsin)
W70-05083

MICROBIOLOGY OF DOMESTIC WASTES. III. METABOLISM OF LAS-TYPE DETERGENTS BY BACTERIA FROM A SEWAGE LAGOON,
Manitoba Univ., Winnipeg. Dept. of Microbiology.
Harvest Halvorson, and M. Ishaque.
Canadian Journal of Microbiology, Vol 15, p 571-576, 1969. 5 fig, 1 tab, 21 ref.

Descriptors: *Sewage lagoons, *Biodegradation, *Domestic wastes, Detergents, Metabolism, Temperature, Bacteria, Waste treatment, Seasonal.
Identifiers: *Linear alkylate sulfonate, *LAS, Alkyl benzene sulfonate, ABS, Methylene blue active substance, Commercial LAS, Liqui-nox, Cold weather.

Effects of physical parameters on metabolism rate of alkyl benzene sulfonate (ABS) and linear alkylate sulfonate (LAS)-detergents such as Liqui-nox, commercial LAS, C-sub-11.3 (mean chain length 11.3 carbon atoms) LAS, C-sub-13.3 carbon LAS, alpha-11 LAS, and alpha-14 LAS are described. Biodegradability of the detergents was studied using bacteria from a sewage lagoon. LAS degraded about 97.5% at 25C over 120 hours. Slight differences in biodegradability were not significant. The metabolism of alpha-14 LAS and Liqui-nox was studied as function of temperature. From 25C to 10C the time required for utilization increased 2.5. No usage of either detergent occurred at 2C over 12 days. Bacteria recovered from

under the ice-cover were not able to degrade either alpha-14 LAS or Liqui-nox at 2C even in the presence of oxygen. The liqui-nox metabolism was measured as a function of aeration; it was not catabolized in the absence of oxygen. Resident methylene blue active substance (MBAS) in a lagoon and its metabolic rate by bacteria were studied as a function of seasonal changes. Between June and October 1966 concentrations of MBAS varied from 4.2 to 8.2 ppm. The significance of the results is discussed with respect to management of sewage lagoons where seasonal changes occur. (Haskins-Wisconsin)
W70-05100

A STUDY OF WATER POLLUTION CONTROL IN THE TEXTILE INDUSTRY OF NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
Dale I. Gramley, and Milton S. Heath, Jr.
Available from the Clearinghouse as PB-190 572, $3.00 in paper copy, $0.65 in microfiche. Report No. 21, WRRI-UNC, January 1970. 94 p. OWRR Project A-004-NC.

Descriptors: *Textiles, Water pollution sources, *Industrial wastes, *Waste treatment, Water utilization, Waste water reclamation, *Water pollution control, *Water reuse, Water quality.
Identifiers: *North Carolina.

This study is a segment of a larger project - Comparative Analysis of Selected State Water Pollution Control Programs - and is intended to add a further dimension through an economic analysis of waste treatment practices of the textile industry in North Carolina. The opening chapters of the report review North Carolina textile history, general economic rationale of water pollution abatement, review of production processes and waste technology, and case studies of water utilization in textile plants. The report is introduced by a series of observations dealing with least cost solutions, textile economy, application of economic analysis to water quality management and role and effect of state water quality management programs. (Howells-North Carolina)
W70-05124

STUDY OF A WATER-VAPOR ELECTROLYSIS UNIT,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 05A.
W70-05134

UNIQUE TREATMENT PLANT FOR NORTH GEORGIA.
T. Maddox.
Water and Sewage Works, Vol. 109, p325, 1962.

Descriptors: *Industrial waste, *Waste treatment, *Treatment facilities, *Waste water treatment, Waste waters, Water pollution, Biological treatment, Aeration, Micro-organism.
Identifiers: *Textile mill wastes.

An industrial wastes treatment plant has been constructed for the Chicopee Manufacturing Corporation's textile factory at Gainesville, Georgia. Waste waters from this factory were discharged into Bailes Creek before pollution was increased by the construction of Lake Lanier. The new plant will provide single-stage biological treatment with aeration for up to 40 hours to enable the micro-organisms to become adapted to variations in the composition of the waste water, thus avoiding the need for further treatment. (Mattox and Livengood - North Carolina State Univ)
W70-05164

WHERE DOES RESEARCH STAND IN WATER POLLUTION.
H. G. Hanson, and B. B. Bergen.
Journal of the Water Pollution Control Federation, Vol. 33, p477-484, 1961.

Descriptors: *Separation techniques, Water pollution, Water pollution control.
Identifiers: *Research, Purification.

In this review three questions are answered: (a) who is doing research, (b) what is being done in research, and (c) what are the resources for doing research. Approximately 2/3 of all research is done by universities, and the remainder is done by industries, states, and municipalities. The research projects fall into 6 categories: (1) origin and behavior of wastes, (2) treatment of waste, (3) disposal of wastes, (4) stream monitoring and surveys, (5) treatment of water, and (6) conservation. The nation's developed resource for research in water supply and pollution control is extremely limited. The report includes discussions on accounting for all the wastes reaching streams, predicting the pollutional character of new wastes, adequate treatment of wastes, effective use of the receiving water, intelligent and effective monitoring of receiving waters, effective treatment of polluted water for reuse, and the problems of separation and purification. (Robinson-North Carolina State Univ)
W70-05165

FEASIBILITY STUDY FOR GLENDALE - LOS ANGELES WATER RECLAMATION PLANT (CONDENSATION),
Engineering Science, Inc., Oakland, Calif.; and Koebig and Koebig, Inc., Los Angeles, Calif.
For primary bibliographic entry see Field 03C.
W70-05254

ALGAL FLOCCULATION WITH SYNTHETIC ORGANIC POLYELECTROLYTES,
Notre Dame Univ., Ind. Dept. of Civil Engineering.
Mark W. Tenney, Wayne F. Echelberger, Jr., Ronald G. Schuessler, and Joseph L. Pavoni.
Applied Microbiology, Vol 18, No 6, p 965-971, 1969. 8 fig, 11 ref.

Descriptors: *Algae, *Flocculation, *Waste water treatment, Electrolytes, Chemical reactions, Electrochemistry, Resistivity, Chlorella, Scenedesmus.
Identifiers: *Polyelectrolytes, *Synthetic organic polyelectrolytes, Cationic electrolytes, Algal surface charge, Electrostatic repulsion, Dow C-31, Dow A-21, Nalco N-670.

Catonic, anionic, and nonionic synthetic polyelectrolytes were used in attempts to remove algae from waste waters. Under conditions of the study, flocculation of algae was caused only by cationic electrolytes. The mechanism of flocculation is interpreted as bridging phenomena between algal cells and the matrix of lineary extended polymer chains. The flocculation requires a reduction in the algal surface charge to a level at which the extended polymers can overcome electrostatic repulsion. The rate of application of cationic flocculants depends upon pH of the medium, algal concentration, and algal growth phase. (Wilde-Wisconsin)
W70-05267

CONVENTIONAL AND ADVANCED WASTE TREATMENT,
Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 03C.
W70-05277

TECHNICAL PROBLEMS CREATED BY REUSE,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 03C.
W70-05278

HOUSEHOLD WASTE WATER,
National Swedish Inst. for Building Research, Stockholm.
For primary bibliographic entry see Field 05B.
W70-05304

CONTINUOUS MICROBIOLOGICAL PURIFICATION OF WASTE-WATER FROM PAPER AND WALLBOARD INDUSTRIES,
Lund Inst. of Tech. (Sweden).
For primary bibliographic entry see Field 05F.
W70-05305

CONTRIBUTION BY COMMONWEALTH TO COST OF ABATING POLLUTION.

Pa Stat Ann tit 35, secs 701-703 (1964), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Sewage treatment, *Cost repayment, *Cost sharing, Water pollution, Financing, Construction costs, Operating costs, Maintenance costs, Replacement costs, Pollution abatement, Sewage, Local governments, Sewers, Pumping plants, Payment, Stream improvement, Cities, State governments, Legal aspects, Legislation, Costs.

Where constructed in accordance with the 1937 Clean Streams Program the Commonwealth of Pennsylvania will pay up to 2% of the cost of those sewage treatment plants acquired or constructed by municipal authorities or school districts. The word 'construction' shall include the construction of new treatment facilities and the altering or improving of existing treatment facilities. Determination of the amount of such contribution shall be made by the governor upon recommendation of the Secretary of Health. In cases where the treatment facilities are acquired or constructed by the State Public School Building Authority and thereafter leased to a local school district, payment from the Commonwealth toward the cost of operating, repairing or replacing the facilities shall be made to the school district. (Dearing-Florida)
W70-05353

BIODEGRADATION OF NITRILOTRIACETIC ACID IN AEROBIC SYSTEMS,
Wisconsin Univ., Madison. Water Chemistry Lab.
Bernhard H. Pfeil, and G. Fred Lee.
Environmental Science and Technology, Vol 2, No 7, p 543-546, 1968. 7 fig, 2 tab, 6 ref.

Descriptors: *Biodegradation, *Waste treatment, *Aerobic treatment, *Eutrophication, Water pollution control, Biochemical oxygen demand, Chemical oxygen demand, Activated sludge, Chemical analysis, Sewage treatment, Volumetric analysis, Wisconsin, Acclimatization, Dissolved oxygen.
Identifiers: *Nitrilotriacetic acid, NTA, Waste treatment biota, Madison (Wis), Nine Springs Treatment Works (Wis), University of Wisconsin, Mixed liquor suspended solids.

Because of role of phosphate detergents in eutrophication, search for suitable substitutes in receiving increasing emphasis. One proposed substitute, NTA (sodium salt of nitrilotriacetic acid), a strong complexing agent may have effects on biota of waste treatment processes. Because previous evidence regarding biodegradability of NTA was equivocal, study of its degradation in biochemical oxygen demand (BOD) test and laboratory activated sludge units was undertaken. Disappearance of NTA in activated sludge was quantitated by titration with copper salt in presence of sodium acetate, with or without indicators (catechol violet; murexide). In activated sludge, NTA was biologically degraded only after acclimatization of microorganisms to compound for one week. With NTA loadings up to 110 milligrams/liter, concentrations higher than normally expected in municipal sanitary wastewater, compound was easily degraded by acclimated organisms from secondary treatment processes. BOD (5 days) of NTA is zero unless organisms, utilized to seed determination, were similarly acclimatized. Oxygen in BOD test, seeded with acclimated organisms, was reduced below 0.05 milligrams/liter after 13 days in presence of 20 and 100 milligrams NTA/liter. In absence of NTA for periods up to 2 days, acclimated organisms did not lose ability to degrade compound. (Eichhorn-Wisconsin)

W70-05379

POLLUTION CONTROL CAN BE PROFITABLE,
Baldwin-Lima-Hamilton Corp., Philadelphia, Pa. Heat Transfer Engineering Dept.
John G. Gaydos, and Alfred N. Rogers.
Water and Wastes Engineering, November 1969, 2 p. 2 fig, 4 tab.

Descriptors: *Water pollution control, *Profit, Water reuse, Desalination, Waste water treatment, Application methods, Chemical wastes, Wastes, Industrial water, Industrial wastes, Income, Effluents.
Identifiers: Chemicals manufacture wastes, Feed conditioner, Flash distillation unit, Byproducts.

A hypothetical factory which manufactures fine chemicals, requires substantial quantities of comparatively pure water and has a plant effluent of roughly 2% dissolved salts is considered. The proposed solution involves a multi-stage flash distillation unit and a crystallizer. Conditioned effluent is fed to a multi-stage flash distillation unit which recovers 88% of the water content and returns ultrapure distillate to the chemical plant. The blowdown from the distillation unit proceeds to a crystallizer which recovers the balance of the water content. Solids discharged from the crystallizer are centrifuged, dried, and packaged for sale as highway de-icer. The income in dollars per day and the quality of valuable byproducts recovered are presented. In balancing costs versus value of recovered products, a profit of 12.9% (20-year life) is derived from the original investment. (Haskins-Wisconsin)
W70-05392

EFFECTS OF LOADING ON A BIOLOGICAL TERITIARY TREATMENT SYSTEM,
Washington Univ., Seattle. Dept. of Civil Engineering.
H. Kirk Willard, and D. A. Carlson.
Presented at the 23rd Annual Purdue Industrial Wastes Conference, Lafayette, Indiana, May 9, 1968. 25 p. 12 fig, 20 ref.

Descriptors: *Effluents, *Waste treatment, *Tertiary treatment, Treatment facilities, Biological treatment, Phosphorus, Nitrogen, Biochemical oxygen demand, Rotifers, Analytical techniques, Model studies.
Identifiers: Particulate scrubbing system, Aufwuchs biocoenose, Ciliates, Bacterial grazers, Suspended solids removal.

A two-phase biological tertiary waste treatment system is proposed for rapid removal of suspended solids and carbonaceous material. The system consists of a biosynthesis step and a particulate scrubbing unit, called an aufwuchs biocoenose. Data collected from a continuous flow bench scale model indicated that the activity of aufwuchs organisms, under imposed conditions, could be described by a mathematical equation relating loading in terms of bacterial suspended solids concentration and stationary surface area. Aufwuchs maximum growth rate constant was 0.026/hour and the half-rate substrate concentration was 6.2 milligram/liter. A biomass yield of 16% of the influent suspended solids for the particulate feeders produced a low effluent solids concentration of 0.069 milligram suspended solids/milligram biochemical oxygen demand (BOD) removed. Total dissolved organic carbon was destroyed above 90% in the bacterial and aufwuchs unit. Similar removal values of 90% to 94% were measured for BOD. Decrease of both organic carbon and BOD were higher at lower loading rates. Most nitrogen compounds were oxidized to nitrates with percent of nitrification decreasing with increasing loadings. Phosphates were not removed except for the amount incorporated into wasted cell biomass ranging in magnitude from 22 to 36%. (Haskins-Wisconsin)
W70-05419

MANAGEMENT OF CATTLE FEEDLOT WASTES,
Iowa State Water Resources Research Inst., Ames.
Richard R. Dague, and Kenneth J. Kline.
Available from the Clearinghouse as PB-190 830, $3.00 in paper copy, $0.65 in microfiche. Iowa State Water Resources Research Institute Report No 69-4, Iowa University, Project Completion Report, June 30, 1969. 195 p, 99 fig, 20 tab, 19 ref, 4 append.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.
Identifiers: Feedlot wastes, Waste management.

The effects of hydrologic factors on the control of runoff from open feedlots were studied. Management and treatment techniques are discussed and evaluated. Rainfall, runoff, and streamflow are the primary factors to consider in managing cattle feedlot runoff. The nature, volume, and rate of delivery of runoff are directly related to rainfall. Storage requirements depend upon the volume of runoff, whereas the retention pond discharge rate should be proportional to streamflow. Terraces and retention ponds will reduce the pollution from cattle feedlot runoff. Application to land appears to be the most practical method of disposal for both the solids and the liquid. When applied to agricultural land, the waste has some economic value. Retention ponds may not remove sufficient amounts of suspended solids, BOD, COD, and nutrients to provide safe effluents for disposal to streams. (Knapp-USGS)
W70-05465

REUTILIZATION OF WASTEWATER RECYCLED THROUGH GROUNDWATER, VOLUME 1 AND 2.
Eastern Municipal Water District, Hemet, Calif.

Available from the Clearinghouse as PB-190 790 (Vol. I), and PB-190 791 (Vol. II), $3.00 each in paper copy, $0.65 each in microfiche. Progress Report to Federal Water Pollution Control Administration for Project 16060, December 1968. Volume 1 - 125 p, 45 fig, 20 tab, 13 ref, Volume 2 - 87 p, 61 ref, 3 append. Grant FWPCA 16060 DDZ --- 12/69.

Descriptors: *Artificial recharge, *Water reuse, *California, Water yield, Infiltration, Water spreading, Pit recharge, Safe yield, Water balance, Hydrogeology, Data collections, Hydrologic data, Groundwater movement, Water quality, Water levels, Water supply, Water utilization, Surveys, Geophysics.
Identifiers: San Jacinto Valley (Calif).

The water quality factors involved in the recharging of the San Jacinto Basin, California are evaluated so that the overall operation may be conducted in a manner to provide adequate protection of groundwater quality while permitting reclamation of wastes for regional water conservation. Another objective is to study the benefits to the salt balance problem caused by recharging. In the previous situation, some effluents were discharged to the San Jacinto River area and some were used as irrigation water. With recharge there is a significant reduction in evapotranspiration losses, thus improving groundwater quality by diluting the dissolved salts. The safe groundwater yield is limited to approximately 11, 205 acre-feet/year. The volumes of water reclaimed and put underground to replenish the overdraft now average approximately 1430 acre-feet/year. Withdrawals now approximate 12,000 acre-feet/year, and importation of Colorado River water approximates 1900 acre-feet/year. Inflow of salt into the basin is now estimated at 5800 ton/year; 3900 ton/year from inflowing groundwater and 1900 ton/year from imported Colorado River water. (Knapp-USGS)
W70-05466

REMOVAL OF SELECTED CONTAMINANTS FROM WATER BY SORPTION OF COAL,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
Paul H. King, Francis R. McNeice, and Pierre S. Warren.
Available from the Clearinghouse as PB-190 802, $3.00 in paper copy, $0.65 in microfiche. Virginia Polytechnic Institute Water Resources Research Center Bulletin 32, November 1969. 75 p, 34 fig, 3 tab, 37 ref. OWRR Proj No A-015-VA.

Descriptors: *Tertiary treatment, *Phosphorus compounds, *Nutrients, *Pesticides, *Water pollution control, Eutrophication, Algae, Filtration, Sorption, Flocculation, Coal, Activated carbon.
Identifiers: Coal contact processes, Pesticide removal.

Removal or limitation of soluble phosphorus in wastewater effluents is a key factor in alleviating the aesthetic and economic problems associated with excessive algal growth. Very dilute concentrations of long-lived pesticides can in time be lethal to animals exposed to them. If dangerous or potentially dangerous concentrations of pesticides exist in water utilized for human consumption, methods must be developed to remove them easily and economically. Activated carbon is very effective in adsorbing organic compounds from dilute solution. The high cost of this adsorbent, however, often prohibits its use in large-scale treatment processes. Coal is relatively low in cost and thus is an attractive filter media if the removal of dissolved material by sorption can be accomplished concurrently with the elimination of suspended solids by filtration. Although coal is a poorer sorbent than is activated carbon, it is considerably more economical and can be incinerated after exposure to a wastewater stream. The extent of uptake of selected phosphorus containing compounds and synthetic organic pesticides by coal were evaluated in both batch continuous flow operations. The kinetics of the uptake process as well as the capacity of the coal for the sorbate at equilibrium are reported. (Knapp-USGS)
W70-05470

5E. Ultimate Disposal of Wastes

SUBSURFACE DISPOSAL OF INDUSTRIAL WASTES,
Michigan State Geological Survey, Lansing.
Robert E. Ives, and Gerald E. Eddy.
Interstate Oil Compact Commission Study, Oklahoma City, June 1968. 109 p, 6 fig, 3 tab, 62 ref, 3 append.

Descriptors: *Waste water disposal, *Industrial wastes, *Injection wells, Surveys, Aquifers, Hydrogeology, Legal aspects, Water law, Water chemistry, Water pollution, Geology, Regulation, Monitoring, Well regulations.
Identifiers: Waste disposal wells.

Underground waste disposal policies and practices in the U.S. are compiled and reviewed. A questionnaire was compiled and sent out to establish information on the nature, seriousness, legal aspects, and method of handling these problems as they exist in each of the states. Another questionnaire was sent out that dealt specifically with individual subsurface waste disposal wells. A short discussion of pollution problems includes information on the nature and seriousness of the pollutants and the treatment methods currently being used. Physical considerations of use of underground reservoirs may affect other values and other uses of these reservoirs for reasonable purposes. Legal considerations and resulting complications are discussed. A summary coverage of disposal systems and disposal wells now in use in the various states includes comments on state policies, regulations and enforcement. Recommended practices and procedures in the establishment of guidelines concerning initial processing of applications, drilling, monitoring, and final abandonment of disposal wells are given. (Knapp-USGS)

W70-05181

MANAGEMENT OF CATTLE FEEDLOT WASTES,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 05D.
W70-05465

STORM AND COMBINED SEWER DEMONSTRATION PROJECTS, JANUARY 1970,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
For primary bibliographic entry see Field 05G.
W70-05467

HYDRAULIC AND MIXING CHARACTERISTICS OF SUCTION MANIFOLDS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
For primary bibliographic entry see Field 05G.
W70-05468

PERSPECTIVE ON THE REGULATION OF UNDERGROUND INJECTION OF WASTEWATERS,
Ohio River Valley Water Sanitation Commission, Cincinnati; and Federal Water Pollution Control Administration.
For primary bibliographic entry see Field 05G.
W70-05521

5F. Water Treatment and Quality Alteration

PHYTOPLANKTON AS AN AGENT OF THE SELF-PURIFICATION OF CONTAMINATED WATERS,
Foreign Technology Div., Wright-Patterson AFB, Ohio.
G. G. Vinberg, and T. N. Sivke.
Available from the Clearinghouse as TT-67-62992, and AD-659 310, $3.00 in paper copy, $0.65 in microfiche. Translation by Foreign Technology Division, Wright-Patterson Air Force Base, FTD-MT-66-13, August 18, 1967, 37 p. Trans. from Trudy Vsesoyuznogo Gidrobiologicheskogo Obshchestva, Vol 7, p 3-23, 1956.

Descriptors: *Phytoplankton, *Self-purification, *Waste water (Pollution), *Water purification, Algae, Sewage, Anaerobic, Oxygen, Nitrification, Coliforms, Ponds, Climates, Photosynthesis, Productivity, Symbiosis, Reservoirs, Lakes, Reaeration, Seston, Chlorophyll, Cycles, United States, Chlorella, Biochemical oxygen demand, Oxidation lagoons, California, Texas, Depth, Retention, North Dakota, Ice, Snow, Carp, Salmon, Irrigation, Filtration, Organic matter, Ammonia, Hydrogen ion concentration, Antibiotics, Symbiosis, Euglena, Light intensity, Nutrients, Temperature.
Identifiers: Piscicultural ponds, Svisloch' River (USSR), Minsk (USSR), England, Oscillatoria, Australia, Santa Rosa (Calif), Lyublin (USSR), Lyuberets (USSR), Munich (Germany), Chlorella pyrenoidosa, Bichoromate, Dry weight, B coli communae, Euglene gracilis, Protococcales.

Planktonic algae grown on a large scale on undiluted city sewage sharply accelerates self-purification processes; it is expressed in faster initial lowering of the biochemical oxygen demand, early termination of the anaerobic phase, appearance of free oxygen, and in the accelerated onset of nitrification. Accumulation of a large quantity of organic substances synthesized by the algae in the composition of the bodies of the living cells is not reflected in the magnitude of the biochemical oxygen demand. The death rate of coliform bacteria increased sharply with the large-scale development of green algae in self-cleaning sewage. Euglena and Chlorella are compared. Ponds, filled with undiluted sewage, are the simplest method to use green organisms as agents of self-purification and is an especially effective method of water reclamation, particularly applicable to warm, dry, climatic regions. Further study of favorable conditions for development of photosynthesizing plankton organisms will alleviate problems in large-scale cultivation of algae as a method of utilizing sewage and particularly should clarify the applicability of using algae grown on sewage to increase the productivity of piscicultural ponds. (Jones-Wisconsin)
W70-05092

HYDRAULICS OF STRATIFIED FLOW - SECOND PROGRESS REPORT SELECTIVE WITHDRAWAL FROM RESERVOIRS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-05251

THE LIMITED WAR ON WATER POLLUTION,
Gene Bylinsky.
Fortune, Vol. 81, No. 2, pp. 102-107, 193-195, 197, Feb. 1970. 10 p, 5 fig.

Descriptors: *Impaired water quality, *Water pollution, Water pollution sources, Water treatment, Water quality act, Sewage treatment, Governments.

The federal government, along with state governments, are increasing their efforts and expenditures towards stopping water pollution and cleaning up polluted waters. The volume of pollutants keeps expanding while water supply stays basically the same. Therefore, more intervention will be required to just keep water pollution from getting worse. A diagrammatic view of water treatment is presented. The following aspects of water pollution are discussed; the demand for oxygen in water, what level of cleanliness of water is desired, sewage treatment by mechanical means, lack of treatment for algal and foam, coping with bacteria, turning brackish water into potable water, coping with sludge, drafting of water quality standards, and finally, the lack of imagination of the federal approach to water pollution control. (Grossman-Rutgers)
W70-05280

CONTINUOUS MICROBIOLOGICAL PURIFICATION OF WASTE-WATER FROM PAPER AND WALLBOARD INDUSTRIES,
Lund Inst. of Tech. (Sweden).
Ivar H. Sanick, and Gunnar Sjostrom.
Available from the Clearinghouse as PB-188 194, $3 in paper copy, 65 cents in microfiche. Acta Polytechnica Scandinavica, Ch 86, Royal Swedish Academy of Engineering Sciences, Stockholm, Sweden, 1969. 34 p, 11 tab, 13 fig, 10 ref.

Descriptors: *Pulp wastes, Pulp and paper industry, Wood wastes, *Water purification, *Fungi, Metabolism, Enzymes, Carbohydrates, Biological treatment.
Identifiers: *Coniophora cerebella, Sweden.

The fast growing strain of Coniophora cerebella called 'G' and isolated (I.S.) by ultra sound treatment of a suspension of the original strain of C. cerebella, has proved to tolerate extreme environmental conditions. After more than 4 years the G-strain has not shown any tendency to degenerate in the presence of other soil micro-organisms. With the faster growth and spread it is not surprising to find that also the sclerotia formed quicker than with the original strain. The sclerotium formed has been closer investigated by micro-photography of frozen sections. Growing on different kinds of wood it was found that the C. cerebella G will grow twice as fast on cross-cuts of pine as on cross-cuts of common birch. Tests with waste-water have shown that in practice nothing is to be gained by adjusting the original pH-values prior to the enzymatic break-down on fibres and dissolved carbohydrates. In purification tests of waste-water the pH will rise from 3.8 to 5.9 after a flow distance of 72 m over bed. The BOD of waste-water after purification and correction for water evaporation had dropped from 2150 mg/l to 234 mg/l after a flow distance of 104 m over bed. The corresponding drop in COD was from 5590 mg/l to 517 mg/l.
W70-05305

HEALTH AND SAFETY (WATER SUPPLY).

Pa Stat Ann tit.35, secs 711-716 (1964), as amended (Supp 1969).

Descriptors: *Pennsylvania, *Water works, *Water supply, *Potable water, Water sources, Permits, Public health, Public utilities, Administrative agencies, Planning, Surveys, Construction, Judicial decisions, Legal aspects, Water purification, Water treatment, Equipment, Water distribution (Applied), Water quality, Standards, Legislation, Regulation, Water works, Water quality control.

Any person, company or corporation supplying water to the public must file with the Commissioner of Health a copy of the plans of their waterworks and a description of the source of their water supply. No additional source of supply may be used without a permit from the Commissioner, nor may waterworks be constructed without a permit. Permits will only be granted if the source of water supply is approved. Decisions of the Commissioner may be appealed to the courts in accordance with the specified procedures. The Department of Health may take such action as is necessary to insure the potability of water and the maintenance of proper treatment equipment by every permittee. Upon the failure of any permittee to meet Department standards of potability or treatment equipment, the Department may, by court permission, take over the permittee's facilities and make the needed corrections. The cost of all such corrections shall be borne by the delinquent permittee. (Dearing-Florida)
W70-05354

WATER POLLUTION CONTROL AND PUBLIC WATER SUPPLY.
For primary bibliographic entry see Field 05G.
W70-05356

HEALTH AND SAFETY (BOTTLED WATER).
Pa Stat Ann tit. 35, secs 1001-1006 (1964).

Descriptors: *Pennsylvania, *Water pollution, *Potable water, *Public health, Water delivery, Water pollution control, Water quality, Mineral water, Spring waters, Permits, Administrative agencies, Inspection, Water supply, Regulation, Legal aspects, Legislation, Water, Water quality control.
Identifiers: *Bottled water.

No polluted or otherwise impure or injurious water may be bottled or sold for drinking purposes. Annual permits to be issued by the Department of Health are required for the manufacture and sale of bottled water. These permits may be denied or revoked by the Department if, after thorough investigation and inspection, the water so bottled and sold is found to be impure or injurious to the public health, or if it bears evidence of potential pollution. The Department may establish rules and regulations for the effective enforcement of these provisions. Violation of these regulations or of this law shall constitute a misdemeanor. This act shall not apply to the manufacture or sale of carbonated beverages or still drinks. (Dearing-Florida)
W70-05368

ALGAE IN WATER SUPPLIES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
C. Mervin Palmer.
U S Public Health Service Publication No 657, 1959. 88 p. 55 fig, 13 tab, 170 ref, 6 plates, appendix.

Descriptors: *Algae, *Water supply, *Control, Taste, Odor, Filters, Plankton, Water pollution, Surface waters, Reservoirs, Control, Bibliographies, Analytical techniques, Diatoms, Sampling, Physicochemical properties, Centrifugation, Microscopy, Nets, Nannoplankton, Pigments, Chlorophyta, Cyanophyta, Chrysophyta, Rhodophyta, Euglenophyta, Slime, Color, Corrosion, Distribution systems, Coagulation, Water softening, Toxicity, Marine algae, Fresh water, Parasitism, Water treatment, Indicators, Waste treatment, Copper sulfate, Algicides, Photosynthesis.
Identifiers: *Identification, *Significance, Algal key, Clump count, Desmids, Flagellates, Mesoplankton, Microplankton, Pseudoplankton, Cryptophyceae, Volvocales, Industrial uses, Clean water, Genus, Species, Touch sensation.

Continued surveillance of algal populations under a planned and uniform approach is needed to put information in an understandable and useful form. This manual is an attempt to appraise nuisance organism problems and furnish information for remedying some difficulties. It deals with the ecology and life history of algae and gives information on filter clogging, mat-forming algae, attached forms, algicides, and algal control. Large quantities of algal material cause serious difficulties in water treatment plants. Certain diatoms almost invariably reduce the length of filter runs. Synura, is a taste and odor producer. Low concentrations of most algae are often an asset in raw waters. A simplified key of 289 species with drawings of most important is given. The algae are considered and displayed according to their significance to sanitary scientists and technicians rather than with regard to their evolutionary relationship. Most algae of importance in water supplies may be characterized in four general groups: blue-green algae, green algae, diatoms, and pigmented flagellates. A few miscellaneous forms do not fit into these four groups. Polluted water algae, clean water algae, plankton, and other surface water algae are included. (Jones-Wisconsin)
W70-05389

STATE BOARD OF HEALTH.

Del Code Ann tit 16, sec 122 (1953), as amended, (Supp 1966).

Descriptors: *Delaware, *Sanitation, *Administrative agencies, *Public health, Legislation, Legal aspects, Administration, Environmental sanitation, Recreation, Sanitary engineering, Social aspects, Urbanization, Water quality, Water pollution, Drainage, State governments, Sewage disposal, Recreation facilities.

The State Board of Health has the duty to : (1) provide for the sanitary protection of all water supplies which are furnished to and used by the public; (2) provide for the proper collection, storage, and disposal of sewage by public authorities and individuals; (3) provide for the sanitary control of public swimming and bathing places; and (4) regulate plumbing in the interests of public health. The Board of Health advises officers of the state, county, and local governments in regard to drainage and the location, drainage, ventilation, and sanitary provisions of any public institution, building or public place. (Powell-Florida)
W70-05448

5G. Water Quality Control

THERMAL POLLUTION CONTROL - NEED FOR ACTION,
J. I. Bregman.
Thermal Pollution Symposium of the Cooling Tower Institute Meeting, New Orleans, Louisiana, January 30, 1968, p 1-8.

Descriptors: *Thermal pollution, *Thermal power, *Temperature, *Power plants, *Aquatic life, Water quality act, Water quality control, Nuclear power plants, Standards.
Identifiers: Interstate standards, Intrastate standards, Power plant licenses.

By 1980, one-fifth of the total fresh water runoff of the U.S. will be used for cooling. The 95% of thermally-generated electricity that is presently produced by fossil fuel will decline to 65%, and the nuclear plants require 40% more condenser water for a given temperature rise than fossil fuel. The result will be larger, more concentrated loads of waste heat, which threaten the survival of the aquatic life in the streams on which power plants are located. The 1965 Water Quality Act has resulted in the setting of interstate water quality standards in all states, with different types of waters (warm, cold, marine) and different uses assigned different limits. Those standards will be enforced by the states, aided by the federal government if necessary. Many states have set standards for intrastate streams which include temperature changes. The federal government is working to set an example by controlling thermal wastes from nuclear reactors owned by the Atomic Energy Commission. Proposed controls include issuing licenses for construction of plants only when thermal pollution is prevented and providing department review of pending power applications. (Speakman-Vanderbilt)
W70-05052

WISCONSIN WATER RESOURCE PROBLEMS,
Wisconsin Dept. of Natural Resources, Madison.
L. P. Voigt.
Wisconsin Conservation Bulletin, p 3-5, January-February 1970. 2 photos.

Descriptors: *Water quality, *Wisconsin, Phosphorus, Pulp and paper industry, Algae, Aquatic weeds, Recreation, Groundwater, Fish, Flood plains, Irrigation, Pesticides.
Identifiers: Fox River Basin (Wis), FWPCA.

Wisconsin's water problems relate to water quality and not quantity. The southeastern and eastern parts of the state are particularly problematic due to population and industrial concentrations, and subquently increasing demands for quality water for recreation use. The pulp and paper industry represents the largest waste source, with four times the biochemical oxygen demand of municipal wastes. Any solution will demand that the product prices reflect total costs, including environmental damages. Federal allocation funds for industrial and municipal waste treatment plants were only 1/3 of the authorized amount, thus the state's effectiveness in pollution control is hampered. In the past, the problems of silt, nutrients, and pesticides have been tacked by education programs, voluntary action, and cost sharing but intensified land use may require regulatory programs. Only the symptoms of eutrophication have been treated to date via weed harvesting and algae poisoning, but the state is committed to reduce phosphorus loadings from municipal and industrial wastes in Lake Michigan by 1972. Flood-plain management, fish control, and irrigation are other problem areas to be resolved. (Powers-Wisconsin)
W70-05103

WHY WATER POLUTION IS ECONOMICALLY UNAVOIDABLE,
Resources for the Future, Inc., Washington, D.C.
Allen V. Kneese.
Trans-Action, Vol 5, p 31-36, April 1968.

Descriptors: *Municipal wastes, *Water quality, *Water policy, *Economic justification, Economic feasibility, Industrial wastes, Environmental sanitation, Pollutants, Effluents, Water pollution control, Progressive taxes, Assessments, Laws, Benefit-cost theory.
Identifiers: Alkyl benzene sulfonate, Genossenschaften (German model).

The narrow consideration of physical effects (like dead fish) and objectives (every river pure) must be abandoned in favor of an analysis of public values before standards for water quality control can be established. Welfare economics--comparing damage done by wastes to cost of control, show that popular discontent is the major reason for stream pollution reduction, but to date public grievance has been only general and not specific. Industry discharges twice as much waste as municipalities, with amounts and control costs varying from plant to plant even within an industry, based on plant design and age. Thus a uniform effluent standard would impose higher per-unit costs on some plants while an effluent charge or tax, would allow individual adjustment. Pollution control may be most feasible where production processes are changed. Collective facilities may provide the best solution for waste treatment. German model shows that engineering to meet a region's needs is required; waste disposal is regionally managed, one stream reserved for waste disposal only, and major industries and cities in that region are charged according to the amount and quality of their waste outflow. (Powers-Wisconsin)
W70-05108

WATER CONSUMPTION STATISTICS IN THE TEXTILE INDUSTRY WITH SPECIAL REFERENCE TO THE FINISHING INDUSTRY,
H. Droszler.
VEB Zentrales Projektierungsburo der Textilindustrie, Leipsig, Germany Vol. 13, No. 7, p 371-376, 1963. 16 tab, 4 ref.

Descriptors: *Water requirements, Industrial wastes.
Identifiers: *Textile processes, Textile wastes, Fabric.

Because of the need for large quantities of pure water for the wet processing of textiles and the problems of disposal of this as industrial waste water, there is an increasing need for careful planning of operations. Tables and flow diagrams present detailed data on the amounts of water required per kilogram of fabric in these operations. Use of minimum amounts of water and its recirculation are emphasized. (Work - North Carolina State University)
W70-05130

WHERE DOES RESEARCH STAND IN WATER POLLUTION.
For primary bibliographic entry see Field 05D.
W70-05165

WATER POLLUTION CONTROL,
Paul D. Haney.
Water and Sewage Works, Vol. 106, p305-311, 1959.

Descriptors: *Water pollution control, *Water quality, Self-purification, Legislation, Dissolved oxygen.

Disposal of water-borne wastes in streams is natural, but it should be done in such a manner as not to destroy or unreasonably degrade the stream. Pollution control is the key to the reuse of water. A discussion of legislative acts over a 10-year period is included. Three graphs are used in a discussion of water-quality criteria. A 3-step approach to the problem of designing requirements for pollution control on a specific stream is given: (a) determination of water uses, (b) application of water-quality criteria in defining suitability of water, (c) formulation of waste-control regulations in accordance with engineering, economic, and equity relationships. Although developments have been made in industrial waste control (i.e., waste treatment and recovery of reusable wastes), no significant advances have been made in sewer treatment. (Robinson-North Carolina State Univ)
W70-05207

CHALLENGE TO RESEARCH BY WATER AND AIR POLLUTION PROBLEMS,
Allied Chemical Corp., New York.
R. W. Hess.
American Dyestuff Reporter, Vol. 45, p441-444, and 459, 1956.

Descriptors: *Water pollution control.
Identifiers: *Water pollution research, *Air pollution research, Water pollution index, Air pollution index, Analytical methods, Dyehouse wastes.

Before sound programs for air pollution control can be established more knowledge about the following is needed: (1) Factors which affect the natural cleaning processes of the atmosphere. (2) Effects of nature's radiant energies on reactions between contaminants with each other, and with atmospheric oxygen and water. (3) Relationships of inversions, turbulence, humidity, diffusion, eddies, temperature, and topography as aspects of meteorological conditions. Research is needed on water and atmospheric quality indices because the present indices are unreliable. Research is also needed on methods for waste control. Points for research attach on waste problems are threefold: (1) Development of production processes which will give the minimum amounts of objectionable wastes. (2) Recovery and utilization on more economical disposal than would be possible without recovery. (3) Research on methods for treating wastes since practical methods are either unknown or are very costly in most cases.
W70-05217

THE ECOLOGY OF A RESERVOIR,
For primary bibliographic entry see Field 05C.
W70-05264

WATER QUALITY MANAGEMENT SYMPOSIUM, PROCEEDINGS.
California Univ., Los Angeles. Water Resources Center.

Pillsbury, Arthur F., (ed.). Report no. 16, University of California, Los Angeles, Water Resources Center, Dec. 1969. 148 pp.

Descriptors: *Water quality control, *Future planning (Projected), Water (Demand), Political aspects, Legislation.
Identifiers: California.

This symposium is based on the theme of water quality management and its impact on man's future. Various articiles are included covering the following areas. Present technology and research needs; the quality of life in the environment of the future; matters before the California ligislature; the status of current ligislation on water quality management, and the policy issues in future water quality management. Appropriate portions of the publication are forwarded with abstracts of those portions. (See also W70-05277 thru W70-05279). (Grossman-Rutgers)
W70-05276

THE CONSTITUTIONALITY OF EFFLUENT CHARGES,
Wisconsin Univ., Madison. Water Resources Center.
S. R. Lyman.
Master of Laws Thesis, University of Wisconsin Law School. Available from the Clearinghouse as PB-190 667, $3.00 in paper copy, $0.65 in microfiche. The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 1-201, May 1969. 201 p, 40 ref.

Descriptors: *Effluents, *Pollution abatement, *Legislation, *Assessments, Water pollution control, Water utilization, Judicial decisions, Waste disposal, Public rights, Public benefits, Administrative agencies, Costs, Governments, Water quality control, Regulation, Taxes, Classification, Water policy, Reasonable use, Water costs, Damages, Impaired water quality, Control systems, Public health, Navigable waters.
Identifiers: *Effluent charges.

Effluent charges are monetary levies upon those who discharge waste into the waters of a state. These levies are determined by the quantity and quality of the waste discharged and computed on the basis of damage done to others by each unit of the discharge. Such a charge would be a valid regulation under the state's police power. Moreover, giving an administrative agency the power to administer an effluent-charge system would not be an unlawful delegation of legislative power. An effluent charge would be a regulatory fee under the police and not a tax. Even if considered a tax, it is an excise tax and would be constitutional. Effluent charges do not violate the Northwest Ordinance which prohibits imposing a tax for the use of navigable waters. The effect on downstream users of allowing the discharger to pollute at a price and the applicability of such a charge to municipal users are considered. State and federal effluent charges as navigational servitudes are also discussed. (See also W70-05321 thru W70-05331). (Caldwell-Florida)
W70-05320

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (EFFLUENT CHARGES--DEFINITION),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 1-21, May 1969. 21 p, 73 footnotes.

Descriptors: *Effluents, *Pollution abatement, *Water pollution control, *Water quality control, Costs, Impaired water quality, Classification, Water utilization, Water demand, Water conservation, Legislation, State governments, Federal government, Waste disposal, Resource allocation, Water pollution treatment, River basin development, Water policy, Public rights, Administration, Water resources, Assessment, Legal aspects.
Identifiers: *Effluent charges.

The continual production of excessive waste threatens to exhaust our available water supply, and the demand for usable water is constantly increasing. The effluent charge is an economic incentive technique for implementing water quality standards. It is a monetary levy imposed on anyone who contributes to water pollution by discharging waste and is computed on the basis of the quantity and quality of the waste so discharged. The basic principle is to require the producer of waste to pay all costs associated therewith. The effluent charge would yield substantial revenue, which could be used to finance administration and costs of water quality control in river basins. This charge is somewhat similar to sewer taxes and charges and highway-use taxes, although there are important differences which may affect constitutionality. There have never been any effluent charges in this country, although they have been used in Europe to good effect. However, there is a rising interest in effluent charges. The main question dealt with is whether such system would withstand constitutional challenge. Water classification is discussed. (See W70-05320). (Caldwell-Florida)
W70-05321

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER--THE POLICE POWER),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 22-52, May 1969. 30 p, 108 footnotes.

Descriptors: *Pollution abatement, *Regulation, *Legislation, *Judicial decisions, Effluents, Water pollution control, Impaired water quality, Reasonable use, Riparian rights, Prior appropriation, Consumptive use, Water rights, Governments, Public benefits, Waste disposal, Control systems, Damages, Costs, Classification, Water utilization, Public health, Hydrology, Assessments, Legal aspects.
Identifiers: *Effluent charges.

A polluter against whom an effluent charge is levied could allege that such charge constituted a taking of private property without just compensation, and was thus unconstitutional. This claim would necessarily be based on alleged vested, private property rights. However, such rights may be regulated by the state under its police power as long as the regulation is calculated to further public health, safety, welfare, or morals, and bears a reasonable relation to the purpose of the regulation. Obviously, pollution control and abatement is a proper legislative purpose. The effluent charge bears a reasonable relation to this purpose in that it is directed toward the cause of pollution and is designed to reduce that cause. Courts generally accept the legislature's judgment on the 'reasonable relation' issue in the absence of extreme circumstances. The effluent charge system is not arbitrary in that it has a rational basis for its existence. Effluent charges are not discriminatory even though different polluters would be charged at different rates. The charge is based on the amount of damage done by each unit of waste discharged. Although this will vary with the different hydrologic characteristics of the water, it is not discriminatory. (See W70-05320). (Caldwell-Florida)
W70-05322

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER--EMINENT DOMAIN),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 53-59, May 1969. 7 p, 35 footnotes.

Descriptors: *Pollution abatement, *Regulation, *Waste disposal, *Water pollution control, Judicial decisions, Effluents, Impaired water quality, Reasonable use, Riparian rights, Consumptive use, Water rights, Governments, Legislation, Control systems, Damages, Costs, Water utilization, Water costs, Public health, Assessments, Legal aspects.
Identifiers: *Effluent charges.

Another argument that might be raised against effluent charges by polluters is that the effluent charge system is a 'taking' of rights, thus falling under the state's power of eminent domain and requiring the payment of just compensation. However, courts have generally held that regulations may cause economic losses to a member of the regulated class, or even prohibit a certain use of property altogether and still not constitute a taking for which compensation must be paid. The regulation may still be valid under the police power. Water pollution control measures have usually been considered police power regulations. Further, any 'right to pollute' which may exist is not separate property but merely a 'use' which may be prohibitied without the payment of compensation. This restraint on the use of water would not amount to a substantial deprivation of all the uses of water, and any harm therefrom would be outweighed by the collective benefit. (See W70-05320). (Caldwell-Florida)
W70-05323

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER-UNLAWFUL DELEGATION),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 60-73, May 1969. 14 p, 51 footnotes.

Descriptors: *Pollution abatement, *Regulation, *Administrative agencies, *Legislation, Water pollution control, Water quality control, Control systems, Water rights, Governments, State governments, Judicial decisions, Administration, Public benefits, Waste disposal, Costs, Classification, Water utilization, Water rights, Impaired water quality, Assessments, Legal aspects.
Identifiers: *Effluent charges.

A waste discharger may argue that placing administrative responsibility for an effluent-charge system

into the hands of a public agency amounts to an unlawful delegation of legislative and judicial power. The agency would be empowered to set rates to be charged upon each unit of waste, which would vary according to many factors, and to assess and collect each polluter's assessed charge. In all states, administrative agencies with varying powers and duties, handle water pollution control and abatement regulation. Generally, courts have held that, if sufficiently clear guidelines for agency action are laid down, legislatures may delegate the reasonable authority necessary to accomplish desired constitutional purposes. A setting forth in reasonably specific terms of agency powers and responsibilities should avoid any question, on these grounds, as to the constitutionality of effluent charges. (See W70-05320). (Caldwell-Florida)
W70-05324

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER--THE TAX POWER),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 74-99, May 1969. 26 p, 117 footnotes.

Descriptors: *Taxes, *Regulation, *Pollution abatement, *Assessment, Tax rate, Costs, Governments, Legislation, Effluents, Administrative costs, Water pollution control, Judicial decisions, Waste disposal, State governments, Federal government, Water quality control, Damages, Public benefits, Control systems, Costs, Classification, Legal aspects.
Identifiers: *Effluent charges, *Fees.

Waste dischargers may contend that effluent charges constitute an unconstitutional tax. However, it can be argued that effluent-charge systems are regulatory measures, with charges being fees rather than taxes. If the purpose of an enactment is for regulation rather than revenue, the measure falls under the police power. Fees collected under an effluent-charge system should be reasonably related to the costs of administering the program and abating the pollution. As long as it is reasonable the size of the fee would not detract from its validity as a police-power measure, nor cause it to become a tax. The purpose of the effluent charge is primarily regulatory. It is designed to control and abate pollution of a state's waters and to benefit the health, safety, and welfare of the people of the state. It is clearly an exercise of the police power. As such, the measure need not comply with state constitutional provisions requiring equality and uniformity, and it does not offend the equal protection clause of the federal constitution. Even if the effluent charge is considered a tax, it is a privilege or an excise tax on the use of the water and is constitutional. (See W70-05320). (Caldwell-Florida)
W70-05325

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE NORTHWEST ORDINANCE--THE TAX POWER),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 100-123, May 1969. 24 p, 141 footnotes.

Descriptors: *Effluents, *Water quality control, *Regulation, *Water pollution control, Industrial wastes, Waste water (Pollution), Rivers, St. Lawrence River, Mississippi River, Legislation, Water pollution, Transportation, Navigable waters, Water quality, Structures, Rates, Taxes, Non-structural alternatives, Tariff, Public health, Federal government, State governments, Legal aspects, Navigation, Pollution abatement.
Identifiers: *Effluent charges.

The two major alternatives to considering an effluent charge as something other than an exercise of the police power are: (1) to consider the charge a toll compensating for the use of improvements on a navigable waterway; or (2) to consider the charge a valid excise tax upon the privilege of depositing waste into the waters. Waste dischargers might argue that such a charge is violative of the Northwest Ordinance and the Commerce Clause of the Constitution, both of which prohibit the imposition of a tax on the use of navigable waters. The Supreme Court of the United States has said that navigable waters are highways of commerce open to all and free from tax for their navigation. The one exception to this rule is the exaction of tolls by the states for the use of improvements on navigable waters. This is not a tax but is compensation for use. This exception can be extended by analogy to the effluent charge. Also, if viewed as an excise tax, effluent charges would not be violative of the Northwest Ordinance provision against taxation of navigation. Such tax would be levied not upon navigation, but upon the privilege of depositing wastes into state waters. (See W70-05320). (Barnett-Florida)
W70-05326

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE DOWNSTREAM USERS),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 124-135, May 1969. 12 p, 48 footnotes.

Descriptors: *Wisconsin, *Water pollution control, *Riparian rights, *Effluents, Judicial decisions, Administrative agencies, Water quality control, Industrial wastes, Discharge (Water), Waste water (Pollution), Rivers, Legislation, Water pollution, Legal aspects, Prior appropriation, Competing uses, Abatement, Water quality, Rates, Regulation, Public health, Federal government, State governments, Economics.
Identifiers: *Effluent charges.

Downstream water users might object to an effluent charge system on the basis that it abrogates their common-law right of action against the upstream waste-discharger. The establishment of the effluent charge system does not necessarily result in such denial of due process to downstream water users. Although the payment of the charge allows the discharge of wastes into the state's waters, any unreasonable discharge would still be subject to an action for an injunction or damages by the downstream users. For example, courts have held that, although the polluter has been sanctioned by a state agency, the particular sanction might be beyond the reasonable exercise of the state police power. This preserves a right of action to the downstream users and compensation for their loss. However, such damage payment by the discharger plus the prior payment of an effluent charge to the state seems unduly harsh. To avoid this and to preserve the common-law right of action, provisions should be made for offsetting the effluent charge by the amount of damages paid to the downstream user. Thus, the effluent charge system would accomplish its purpose of water quality control and maintain the constitutional rights of due process for all parties concerned. (See W70-05320). (Barnett-Florida)
W70-05327

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE MUNICIPAL USERS),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 136-139, May 1969. 4 p, 15 footnotes.

Descriptors: *Wisconsin, *Cities, *Municipal wastes, *Effluents, Water quality control, Liquid wastes, Discharge (Water), Waste water (Pollution), Rivers, Legislation, Water pollution abatement, Water quality, Rates, Regulation, Federal government, State governments, Public health, Water pollution control, Sewage effluents, Sewage disposal, Legal aspects, Administration, Local governments.
Identifiers: *Effluent charges.

Municipal corporations are some of the largest polluters in the nation. Thus they are most likely to challenge the effluent charge system as a denial of due process and equal protection. Courts have noted that municipalities are creatures of the state and as such have no protection against regulation by the legislature. A municipal corporation has no privileges or immunities under the federal constitution which it may invoke against state legislation affecting it. Also, a municipal tax payer has no right of action of the municipality with which he identifies has none. If an effluent charge is enacted by the state legislature, and imposed upon a municipal corporation, neither the corporation nor a municipal taxpayer will have standing to challenge the constitutionality of the effluent charge. (See W70-05320). (Barnett-Florida)
W70-05328

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (FEDERAL EFFLUENT CHARGE--NAVIGATIONAL SERVITUDE),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 140-156, May 1969. 17 p, 88 footnotes.

Descriptors: *Water quality control, *Water pollution control, *Federal government, *Effluents, Wisconsin, Industrial wastes, Waste water (Pollution), Navigable waters, Navigable rivers, Ownership of bed, Riparian rights, Riparian waters, Prior appropriation, Reasonable use, Surface waters, Obstruction to flow, Streamflow, Banks, Legal aspects, Riparian land, Regulation, Public health, Legislation.
Identifiers: *Effluent charges.

A federally created effluent charge may be justified by Congress as a valid exercise of its power under the Commerce Clause of the Constitution. From the time of John Marshall, the federal government has had control over interstate commerce and the navigable waters of our nation. Such control should extend to the authorization of effluent charges, since they are designed in part to benefit, improve, and protect navigation. Any alleged 'taking' by the imposition of effluent charges, such as the taking of the right to pollute reasonably, the taking of the special value of the waste discharger's property, or the taking of the downstream user's right to receive the water undiminished by pollution, does not give rise to a constitutional duty to pay compensation. The effluent charge is considered enacted in furtherance of navigation upon the nation's waterways and is thus an exercise of its navigational servitude. The property taken by effluent charges is subject to this servitude and therefore no compensation is necessary. (See W70-05320). (Barnett-Florida)
W70-05329

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (STATE EFFLUENT CHARGE--NAVIGATIONAL SERVITUDE),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 157-169, May 1969. 13 p, 58 footnotes.

Descriptors: *State governments, *Water quality control, *Effluents, Wisconsin, Industrial wastes, Waste water (Pollution), Navigable waters, Navigable rivers, Riparian rights, Riparian waters, Riparian land, Ownership of beds, Prior appropriation, Reasonable use, Surface waters, Obstruction to flow, Banks, Legal aspects, Regulation, Public health, Eminent domain, Water pollution control, Legislation, Compensation.
Identifiers: *Effluent charges.

Waste dischargers might contend that effluent charges upon the disposal of wastes into navigable water bodies deprive them of property without compensation. However, such charge should not be considered violative of the dischargers' rights where the enactment is declared to be, and is, in aid

of navigation. The state may rely upon this concept of a state navigational servitude instead of, or in addition to, their reliance upon the state's police power and power to tax. Some courts have held that states, as trustees for the benefit of the people, have power to deal with navigable waters of the state in any manner consistent with the improvement of navigation, and that where so dealing with these waters, damaged private rights are not compensable. (See W70-05320). (Barnett-Florida)
W70-05330

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE GENERAL PUBLIC--THE TRUST DOCTRINE),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 170-189, May 1969. 20 p, 82 footnotes.

Descriptors: *Navigable waters, *Effluents, *Water pollution control, *Legislation, Riparian rights, State governments, Wisconsin, Ownership of beds, Water quality control, Navigable rivers, Compensation, Permits, Regulation, Legal aspects, Prior appropriation, Riparian waters, Riparian land, Reasonable use, Surface waters, Obstruction to flow, Public health.
Identifiers: *Effluent charges.

The general public has an interest in the navigable waters of the state that is superior to any right of any individual. Thus, the state, acting for the general public, should be able to establish an effluent charge system without compensating for private rights affected thereby. Such regulations are an exercise of the 'trust doctrine' which declares that the navigable waters of the state are held in trust by the state for the benefit of the public. Regulation by the state for the public's benefit does not deprive the riparian owner of any right. It merely limits the exercise of existing rights. Thus, no compensation need be paid. Some opponents of effluent charges might contend that such charges operate to license pollution of waters in violation of the public trust. Arguments considering both sides are presented. A summary conclusion and a sample proposal for enacting effluent-charge legislation is included herein. (See W70-05320). (Barnett-Florida)
W70-05331

LEGAL CONTROL OF WATER POLLUTION.

University of California, Davis, Law Review, p 1-263, 1969. 263 p.

Descriptors: *Water pollution control, *Pollution abatement, *Governments, *Long-term planning, Legal aspects, Water pollution, Water pollution treatment, Industrial wastes, Treatment facilities, Costs, Federal government, State governments, Interstate compacts, Programs, Groundwater pollution, Oceans, Impaired water quality, Regulation, Administrative agencies, Water quality control, Regions, River basin commissions, Legislation, Water utilization, Encroachment.
Identifiers: Federal Water Pollution Control Act.

An overview of the problem of water pollution control in the United States is presented, with various articles dealing with specific areas of concern. The California system of water pollution control is analyzed, showing how states can deal with the problem occurring in intrastate watersheds. Interstate compacts as a means of controlling pollution in interstate river basins are examined, emphasizing the need for regional river basin commissions with sufficient interstate authority to deal with the problem. Federal water pollution control programs are examined in detail, and a greater federal role is proposed. An inquiry into means by which the private sector of the economy can take a more prominent place in pollution control efforts is presented. The sources and effect of pollution of groundwater are examined, and the special problems of groundwater pollution control are outlined. The problem of pollution of the oceans is discussed, with sources and effects of the various types of pollution explained and solutions proposed. The effect of saline encroachment in the San Joaquin Delta is examined, and the possible effect of negotiated concerted action by concerned groups is analyzed. (See also W70-05343 thru W70-05349). (Caldwell-Florida)
W70-05342

STATE CONTROL OF WATER POLLUTION: THE CALIFORNIA MODEL.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 1-41, 1969, 41 p.

Descriptors: *Water pollution control, *State governments, *Pollution abatement, *Regulation, Industrial wastes, Agricultural chemicals, Water pollution sources, Water pollution, Waste disposal, Impaired water quality, Water utilization, Thermal pollution, Groundwater, Groundwater basins, Encroachment, Reasonable use, Legislation, Riparian rights, Treatment facilities, Costs, Water quality control, Water policy, Planning.

California's five main pollution problems are: agricultural pollution, industry, sewage, salt water encroachment and atomic waste. Prior to 1949, the State Department of Public Health had primary pollution control responsibility, and proceeded on a permit system with rigid criteria for construction of treatment facilities. The current California law, passed in 1949, provides that the Health Department has responsibility for all public health hazards, while state and regional water quality control boards have responsibility for all economic damage to the state. These boards formulate state and regional water policies, set waste discharge requirements and aid individuals in pollution problems. The State Department of Fish and Game maintains an extensive water quality program oriented toward wildlife protection. The common law riparian rights concept is part of California law. The reasonable use and natural use doctrines are recognized, and actions for trespass and nuisance are also available. Damages and injunctions are remedies. The current statutory program has been largely effective. However, it should be re-examined with an eye toward increasing its effectiveness under present conditions. (See W70-05342). (Caldwell-Florida)
W70-05343

WATER POLLUTION CONTROL THROUGH INTERSTATE AGREEMENT.
In U Cal Davis L Rev, Legal Control of Water Pollution, p 43-70, 1969, 27 p.

Descriptors: *Water pollution control, *Interstate compacts, *River basin commissions, *Regions, Coordination, Interstate rivers, Legislation, Administrative agencies, Delaware River Basin Commission, Pollution abatement, Regulation, Treatment facilities, Water Quality Act, Water quality control, Water utilization, River basins, Costs, State governments, Federal government, New England Interstate WPS Compact, Industrial wastes, Impaired water quality, Legal aspects.

When economically significant rivers flow through more than one state, control of water pollution requires interstate cooperation. Interstate compacts, setting up river basin commissions whose responsibility for pollution control extends over the entire basin, are the most logical means for combatting pollution. Several such interstate agencies are now in existence, of which the Delaware River Basin Commission is the most effective. The Lake Champlain Basin Compact, the Tri-state Compact, the Ohio River Valley Compact, the Tennessee, Arkansas, Ohio, Potomac, and Columbia River Basins Compacts, and the Great Lakes Basin Compacts are other agreements now in existence. All agreements except the Delaware Compact suffer from two or more of the following deficiencies: (1) failure to grant the agency concerned authority to deal with water pollution as an integral part of other water resource problems; (2) failure of the agencies to set adequate standards or to enforce the minimal standards set; (3) lack of authority in some agencies to enforce any standard. The above-listed agencies have been largely ineffective in coping with the problem. However, growing national concern, the increasing role played by the federal government, and the effect of the quite successful Delaware River Basin Commission may point the way toward more effective efforts in the future. (See W70-05342). (Caldwell-Florida)
W70-05344

FEDERAL PROGRAMS FOR WATER POLLUTION CONTROL.
In U Cal Davis L Rev, Legal Control of Water Pollution, p 71-104, 1969.

Descriptors: *Water pollution control, *Federal government, *Legislation, *Programs, State governments, Local governments, Regulation, Interstate compacts, Planning, River basins, Administrative agencies, Political aspects, Legal aspects, Pollution abatement, Costs, Treatment facilities, Standards, Water quality control, Grants, Federal jurisdiction, Shellfish, International waters, Conferences, Coordination.
Identifiers: Federal Water Pollution Control Act.

The federal government is committed to a leading role in the effort to control water pollution. Federal programs heretofore have attempted to stimulate state and local efforts, rather than providing direct federal initiatives addressed to the problem. The ineffectiveness of state and local controls, interstate compacts, and private lawsuits suggest that more direct federal action is necessary, as federal efforts are likely to be more effective politically and legally. The current federal program includes the Federal Water Pollution Control Act, which provides financial and technical assistance to state and local authorities in the form of construction, program, research, and comprehensive basin planning grants. Direct federal operations in the areas of planning, research, training, and technical assistance in specific problem areas are authorized. The Act provides for federal sanctions for pollution of interstate or navigable waterways. Abatement proceedings are set up in the Act, the major steps being conferences, then hearings, then, if necessary, court action. The Act sets up water quality standards for interstate waters, and requires states to set their own standards. The Rivers and Harbors Act of 1899 and the Oil Pollution Act of 1924 are other pieces of Federal legislation in this area. It is concluded that the limitation of the federal government to a supporting role in combatting water pollution has curtailed its effectiveness. (See W70-05342). (Caldwell-Florida)
W70-05345

SPECIAL PROBLEMS OF WATER POLLUTION: THE PRIVATE SECTOR.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 105-139, 1969, 34 p.

Descriptors: *Water pollution control, *Water pollution sources, *Industrial wastes, *Remedies, Agricultural chemicals, Water pollution effects, Pollutant identification, Biochemical oxygen demand, Pulp wastes, Effluents, Water pollution treatment, Costs, Thermal pollution, Chemical wastes, Acid mine water, Sludge, Pesticides, Animal wastes, Saline waters, Treatment facilities, Economics, Legislation, Regulation, Water utilization, Legal aspects.
Identifiers: Effluent charges, Incentive programs.

The dramatic increase in water needs makes it imperative that water pollution be controlled. The effects of pollutants on water are varied, but all have the result of making the water unusable. Sources of industrial pollution include pulp wastes, chemical industry wastes, thermal pollution, iron and byproducts from steel mills, acid mine water, food

processing industry wastes, and petroleum wastes. Almost all industries are attempting to control pollution by methods such as lagooning, chemical purification, cooling towers, and filtration, but pollution control measures are uniformly expensive. Agricultural pollution gets into water courses by runoff or seepage, or by direct aerial application. Pesticides, animal wastes, and irrigation pollution (concentration of salts and minerals in irrigated land) are major sources of agricultural pollution. In many areas technology is adequate to deal with pollution, and only funds are needed. In other areas, research is still needed. From the economics standpoint, pollution causes an inefficient allocation of many resources. Several forms of controls may be used: (1) the common law private remedy approach; (2) government regulation and enforcement; (3) payments and incentives; and (4) effluent charges. The latter form, making the polluter rather than society pay the cost of pollution, may have the best chance of success. (See W70-05342). (Caldwell-Florida)
W70-05346

POLLUTION OF GROUNDWATER.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 141-165, 1969. 24 p.

Descriptors: *Groundwater, *Surface-groundwater relationships, *Waste disposal, *Water pollution control, Saline water intrusion, Water demand, Groundwater basins, Water pollution sources, Waste storage, Cesspools, Sewage effluents, Landfills, Seepage, Groundwater movement, Groundwater recharge, Acquifers, Base flow, Water purification, Withdrawal, Legal aspects, Prior appropriation, Standards, Legislation.
Identifiers: *Groundwater pollution.

Groundwater pollution presents a unique set of problems. The travel of such pollution and the archaic legal doctrines which govern groundwater complicate the situation. Waste disposal and salinity are the two major sources of groundwater pollution. Major waste disposal methods resulting in groundwater contamination include: (1) impoundments and lagoons; (2) septic tanks and cesspools; (3) landfills; (4) surface water waste disposal; and (5) disposal wells. Salinity in groundwater may come from sea water intrusion resulting from excessive withdrawals from coastal acquifers, or from irrigation, which eventually leaches out salts in the soil and carries them down to groundwater acquifers. The movement of polluted groundwater makes it difficult to trace the pollutant to its source and to set meaningful waste disposal standards. Natural groundwater purification processes (filtration, absorption, degradation, and dilution) should not be relied on for protection from contamination. Archaic legal doctrines, flowing from the absolute dominion rule, hamper the effectiveness of control programs. Intensive research on pollution travel is needed, and the knowledge applied to setting disposal standards. A re-evaluation of current water-rights doctrine is necessary, and workable means of controlling withdrawal from acquifers to prevent saline intrusions must be developed. (See W70-05342). (Caldwell-Florida)
W70-05347

POLLUTION OF THE SEA.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 167-204, 1969, 37 p.

Descriptors: *Water pollution control, *Oceans, *International law, *Water pollution sources, Water utilization, Regulation, Legal aspects, Pollutant identification, Legislation, Water pollution effects, Marine animals, Water conservation, Damages, Oil, Pollution abatement, Water pollution treatment, Judicial decisions, Nuclear wastes, Radioactive waste disposal, Sampling, Municipal wastes, Thermal pollution, Standards, River and Harbors Act.
Identifiers: *Oil pollution, *Nuclear pollution, Penalties (Civil).

The need for ocean pollution control on both a unilateral and an international basis is acute since the sea is becoming increasingly important as a food and mineral resource. A definition of marine pollution to be effective should encompass all sources of pollution but limit itself to alterations of the water which produce harm to its use. Oil pollution is dramatically increasing, and both national and international regulation is necessary to resolve the problem. The Oil Pollution Act of 1924 and the Rivers and Harbors Act of 1899 are of limited effectiveness. Several international conventions treating the problem exist, but are ineffective. The total prohibition of oil discharges anywhere at sea is necessary, together with strong international sanctions. Nuclear pollution is potentially dangerous. The strict unilateral controls of the United States and Great Britain could serve as examples for international action. International agreement on nuclear pollution control has been hampered by the Cold War. Municipal wastes, including sewage and thermal pollution, present a serious problem. Strong unilateral controls are essential, and international agreements are necessary to coordinate these efforts and to insure that all nations have effective pollution control programs. (See W70-05342). (Caldwell-Florida)
W70-05348

SAN JOAQUIN DELTA: IS NEGOTIATION A SOLUTION.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 209-263, 1969, 54 p.

Descriptors: *Water pollution control, *Salt water intrusion, *Water users, *Negotiations, Water distribution (Applied), Consumptive use, Withdrawal, Agricultural chemicals, Irrigation practices, Economics, Land use, Legislation, Judicial decisions, Acquifer characteristics, Inflow, Water quality control, Water utilization, Impaired water quality, Water pollution effects, Barriers, Water demand, Administrative agencies, Diversion losses, Diversion structures, California.

The San Joaquin Delta is a rich farming area between San Francisco and Sacramento whose watershed covers one-third of California. For many years, saline water intrusion has been the major pollution threat. Export agencies (federal and state) whose projects transport water around the Delta are the largest water consumers. Agricultural, municipal, and industrial consumers also deplete the water supply. Conflict results from these groups' divisive interests. Water quality degradation affects all users, especially the export agencies and agricultural users. Release of waters from upstream dams has in recent years provided a 'stop-gap' means of control, but other means of increasing the water supply are being proposed. Negotiation among competing users has been a fairly effective means of arriving at solutions to the problem, but is questioned whether this process can obtain optimal allocation of water resources. The extreme diversity of interests and the question of whether negotiated solutions will fulfill public needs are causes for pessimism. A set of acceptible water criteria is a probable result of negotiation. Watershed and county protection statutes, the development of a statewide water plan and recognition by the courts of the complex nature of the problem may have a beneficial effect on attempts to control the pollution. (See W70-05342). (Caldwell-Florida)
W70-05349

JOINT USE OF MUNICIPAL SEWERS.
Iowa Code Ann secs 392.1-392.3 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Sewers, *Drainage systems, *Cities, Legislation, Disposal, Pipes, Sewage disposal, Sewage districts, Rates, Assessments, Local governments, Streams, Rivers, Administration, Administrative agencies, Waste water treatment, Municipal wastes, Water supply, Joint costs, Construction costs, Costs, Financing.

When the boundaries of cities or towns join and such cities are located adjacent to a river or stream which furnishes drainage or the source of water supply for such cities, the cities may contract with each other for the joint use of the sanitary sewer system of either of the cities. A consideration mutually agreed upon shall be paid for the use of such sanitary sewer system by the dominant city to the servient one. The city which is to use the other's sanitary sewer system shall have authority to lay all necessary lines connecting the two sewer systems. The city building such lines shall levy special assessments against any property benefited by the sanitary sewer system. Sewer districts may be established with annual levies imposed on property therein to meet the project costs. Such assessments are to be levied in proportion to the benefits received. (Barnett-Florida)
W70-05352

MINING AND SMELTING (DRAINAGE OF MINE WATER).
Wis Stat Ann secs 107.05, 107.06 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Mining, *Water conveyance, *Mine drainage, Permits, Legislation, Iron, Hydraulic mining water, Mine wastes, Controlled drainage, Diversion, Diversion structures, Surface waters, Riparian rights, Consumptive use, Administrative agencies, Public benefits, Public rights, Groundwater, Condemnation, Eminent domain, Legal aspects.
Identifiers: Inverse condemnation.

Every person engaged in mining has the right to convey water away from his mines, either over or below the surface of any adjoining land. If surface streams or lakes are involved, a permit to convey water to the same or another watershed must be obtained from the Department of Resource Development. Provisions are made for notice, hearing, and protection of the rights of downstream riparians. If the miner owns riparian land or land with underground water, he may include a request for a permit to divert and use such water in his mining operations. Permits shall be granted where the public benefits from the mining operation outweigh its impairment of public rights in the stream. Conditions may be attached to the permit and security required to protect the public interest. Where no agreement can be reached with the adjoining land owner as to payment for damages caused by conveyance of water over his land, the person engaged in mining may move to acquire the right to convey. (Cuevas-Florida)
W70-05355

WATER POLLUTION CONTROL AND PUBLIC WATER SUPPLY.

Ohio Rev Code Ann secs 6111.12 thru 6111.30, 6111.99 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Water supply, *Administration, *Water control, Legal aspects, Legislation, Water resources development, Water works, Municipal water, Water pollution, Water pollution control, Public health, Water purification, Taxes, Water storage, Water treatment, Water quality control, Water distribution, Bodies of water, Fluoridation, Administrative agencies, Supervisory control (Power).

The Department of Health exercises general supervisory control over the state's public water supply and water works systems, including all features of construction, operation, inspection, and maintenance of systems for supply, treatment, storage, and distribution, which do or may affect the sanitary quality or flouride content of the water supply. The Director of Health must investigate all complaints of impure water or inadequate flouridation. Procedures for the addition of flouride to public water supply systems are set forth. Periodic analysis of public water must be made by the Department. Unauthorized connections into a public water supply system are prohibited. Procedures for ap-

peal from orders of the Director of Health are established. Tax exemptions for water pollution control facilities are provided. The Water Pollution Control Board may investigate pollution of any state waters and is authorized to enter on public and private property to inspect and investigate conditions of pollution. (Casey-Florida)
W70-05356

METROPOLITAN SEWERAGE DISTRICTS.
Wis Stat Ann secs 66.20-66.208 (1965), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Sewage districts, *Sewage, Legal aspects, Legislation, Sewage treatment, Sewers, Navigable waters, construction, Condemnation, Eminent domain, Costs, Cities, Municipal wastes, Domestic wastes, Industrial wastes, Administration, State governments, Public health, Tax rate, Assessments, Riparian rights.

The county courts may establish metropolitan sewerage districts upon petition by the prescribed number of electors. Real property owners and municipal governments may object to establishment of districts; procedures for hearing and appeal are set forth. The district may detach lands not required by the interests of public health and welfare. Districts may issue bonds for the construction and improvement of sewage systems and may levy direct taxes to pay the principal and interest on such bonds. The district commissioners are authorized to plan, construct, maintain, and operate sewage systems. Districts may cross any navigable state waterway, acquire any property in the district necessary to accomplish its purposes, and make special assessments against property which is served by the districts' sewage system. (Casey-Florida)
W70-05362

FRITZ V BD OF TRUSTEES (ASSESSMENTS FOR CONSTRUCTION OF A SANITARY SEWER SYSTEM).
252 NE2d 567-572 (Ind 1969).

Descriptors: *Indiana, *Sewage disposal, *Local governments, *Cost allocation, Construction costs, Costs, Cost sharing, Government finance, Taxes, Sewage, Judicial decisions, Legal aspects, Financing.
Identifiers: *Sewer systems, Injunctions (Prohibitory).

Trustees of appellee town resolved to install within the town a sanitary sewer system. The resolution provided for assessment of all property within the town to pay for construction of the system. Provision was made for a public hearing to finalize the resolution and allow remonstrances in opposition to the plan. Notice of the hearing was posted in five locations. No remonstrances were filed and the trustees confirmed the resolution and assessed appellant's property. Appellants brought action to enjoin the enforcement of the assessment. The trial court upheld the trustees actions. The supreme court, in reversing, held that appellants were deprived of due process of law by the failure of appellees to give adequate notice of the sewer assessment proceedings. It was uncontradicted that appellants received no actual notice of the hearings. A property owner should not be forced to continually search public records for notice of proceedings affecting his property. When assessment proceedings affect specific property, notice should be given in a manner calculated to provide actual notice to affected individuals. (Dye-Florida)
W70-05366

NATURAL LAKES AND PONDS (POLLUTION OF WATER SUPPLY).

Pa Stat Ann tit 35, secs 731, 732 (1964).

Descriptors: *Pennsylvania, *Lakes, *Ponds, *Wastes, Buildings, Domestic wastes, Water pollution sources, Domestic water, Pollution abatement, Water pollution, Legislation, Legal aspects, Water quality, Impaired water quality, Potable water, Public health, Water quality control, Environmental sanitation, Remedies.
Identifiers: Injunctions (Prohibitory), Penalties (Civil).

It is unlawful to occupy living quarters or permit another to occupy living quarters in a building over a natural lake or pond which is the source of water used for human consumption. Depositing of foreign substances in such waters is also prohibited. Penalties are prescribed. The court of common pleas may enjoin violations of this statute upon application of the Department of Health or any person particularly aggrieved. (Cuevas-Florida)
W70-05369

THE POTENTIAL ROLE OF FISHERY MANAGEMENT IN THE REDUCTION OF CHAOBORID MIDGE POPULATIONS AND WATER QUALITY ENHANCEMENT,
S. F. Cook, Jr.
California Vector Views, Vol 15, No 7, p 63-70, July 1968. 2 fig, 11 ref.

Descriptors: Fish management, Stream improvement, *Water quality control, *Midges, Fish food organisms, Nutrients, Energy transfer, *Food chains, Food webs, Forage fish, Plankton, Algae, *Algal control, Predation, Competition, *Insect control.
Identifiers: *Fishery management, *Chaoborid midges, Clear Lake (Calif), Nutrient energy pathways, Trophic relationships.

Information has been acquired indicating that at least partial biological control of chaoborid midges and planktonic algae may be possible with the use of fish. Two basic concepts pertaining to this relationship have been explored; control through direct influence of predation and control through competition for nutrient energy. The emphasis is placed on the latter concept, and means for its implementation are discussed. The work has centered primarily upon the trophic relationships between the midges and plankton and two species of atherinid silversides and the threadfin shad. (Sjolseth-Washington)
W70-05428

STORM AND COMBINED SEWER DEMONSTRATION PROJECTS, JANUARY 1970,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
William A. Rosenkranz.
Available from the Clearinghouse as PB-190 799, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-36, January 1970. 121 p, 3 fig, 1 tab, 24 ref. FWPCA Project 11000---12/69.

Descriptors: *Sewers, *Urbanization, *Storm drains, Sewage treatment, Sewage disposal, Cities, Research and development, Grants, Federal Government, Water pollution control.
Identifiers: Combined sewers.

Studies sponsored by FWPCA of combined storm and sanitary sewers and treatment of combined wastes are listed, abstracts of completed reports are presented, and active projects are described in information sheets. Subjects needing more research are also listed and described. Equipment, data methods, and criteria for urban drainage projects are outlined. (Knapp-USGS)
W70-05467

HYDRAULIC AND MIXING CHARACTERISTICS OF SUCTION MANIFOLDS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
Ronald E. Nece.
Available from the Clearinghouse as PB-190 800, $3.00 in paper copy, $0.65 in microfiche. Washington University Department of Civil Engineering Hydraulics Lab Technical Report No 26, June 1969. 97 p, 58 fig, 21 ref. FWPCA Project 16080---9/69, Grant WP-00512-5.

Descriptors: *Waste dilution, *Mixing, *Sewage disposal, *Outlets, *Intakes, Sewers, Orifices, Discharge lines, Hydraulics.
Identifiers: Suction manifolds.

Experimental data were obtained on the external hydraulic characteristics and mixing characteristics of suction manifolds to be used in feasibility and design studies of using such devices for predilution in sewer outfalls. Dilution rates and head loss characteristics are given for six single circular side-port manifolds, for multiport manifolds incorporating the same side ports, and for annular ports with and without axial symmetry. Density differentials have relatively little effect on the dilution-head loss characteristics of the configurations tested. Comparison of the two geometries tested shows that the annular-port manifold possesses hydraulic advantages over single circular side-port manifolds. Limitations of operating ranges of the manifolds in sewer outfall applications are delineated. (Knapp-USGS)
W70-05468

PERSPECTIVE ON THE REGULATION OF UNDERGROUND INJECTION OF WASTEWATERS,
Ohio River Valley Water Sanitation Commission, Cincinnati; and Federal Water Pollution Control Administration.
Edward J. Cleary, and Don L. Warner.
Cincinnati, Ohio River Valley Water Sanitation Commission, December 1969. 88 p, 14 fig, 6 tab, 36 ref, 2 append.

Descriptors: *Waste disposal, *Injection wells, *Hydrogeology, *Water law, *Reviews, Regulation, Legislation, Legal aspects, Water pollution control, Groundwater, Aquifers, Ohio River, Sanitary engineering, Environmental engineering, Surveys, Investigations, Political aspects, Administration.
Identifiers: Ohio River Valley, Waste disposal wells, Disposal wells.

The eight states of the Ohio River Valley Water Sanitation Commission (ORSANCO) commissioned a study of policies, procedures and other matters allied to the practice of subsurface disposal. Perspective and guidelines are offered in a monograph on the regulation of underground injection of wastewaters. The first section provides background on public policy issues associated with environmental factors and subsurface-resources, including legislative and legal aspects. Part II discusses administrative procedures, geological evaluation and technical criteria relating to injection-well practice, specifically in the Ohio Valley. There is growing concern that wastewater injection may be proceeding faster than warranted by knowledge and regulatory procedures. A deep-well disposal system near Denver may have triggered earth tremors in the area. Legal concern exists with respect to underground trespass. No state prohibits underground disposal, but nine states subscribe to a policy of either rejecting applications or discouraging them. Only Ohio, West Virginia and Texas have specific legislation pertaining to the regulation of industrial wastewater injection. There is no specific federal legislation on deep-well disposal. Only small areas of the Ohio Valley would appear to be eliminated or significantly limited for waste injection on the basis of the most general consideration of the rock units that are present, their geologic structure, and the groundwater circumstances. For abandonment of an injection system, it is suggested that wells be completely plugged with cement and that a permanent monument be constructed at the well site. (Knapp-USGS)
W70-05521

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

REVERSE OSMOSIS TUBULAR MODULE OPTIMIZATION,
Philco-Ford Corp., Newport Beach, Calif.
For primary bibliographic entry see Field 03A.
W70-05080

RUNOFF FORECASTS BY LINEAR PREDICTIVE FILTER,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-05139

POPULATION MODELS AND TEST POPULATIONS AS RESEARCH TOOLS,
Bureau of Commercial Fisheries, Seattle, Wash. Biological Lab.
For primary bibliographic entry see Field 07B.
W70-05414

MODELS FOR DESCRIBING EXCHANGES WITHIN ECOSYSTEMS,
Wisconsin Univ., Madison. Inst. for Environmental Studies.
Donald G. Watts, and Orie L. Loucks.
Institute for Environmental Studies, University of Wisconsin, Madison, February 4, 1969. 18 p. 8 fig, 8 ref.

Descriptors: *Systems analysis, *Ecosystems, Computer models, Simulation analysis, Model studies.
Identifiers: *Transfer function models, Nutrient transport models, International Biological Program, Ecosystem model, Lake Wingra (Wis).

Recently, attention has been focused on the application of systems analysis to description and modeling of large-scale man-environment-biota interdependency. Through sponsorship of the International Biological Program, systems analysis based transfer function models have been developed for predicting exchanges of materials into, within, and out of the Lake Wingra, Wisconsin, drainage basin. Previous 'compartment' models inclined to be too general in identification of transfer mecahnisms for materials such as nutrients, thus causing inconsistencies between aquatic and terrestrial models. The proposed transfer function models are of fundamental importance to developing ecosystem models with simulation and prediction capabilities. They provide an extremely detailed description of material flow through a lake basin, in a form which is conducive to a single, comprehensive analysis leading to computer simulation studies. (Huff-Wisconsin)
W70-05420

THE 'SOFT' FACTORS IN SYSTEMS STUDIES,
Rand Corp.
James R. Schlesinger.
Bulletin of the Atomic Scientists, Vol 24, No 9, p 12-17, Nov 1968.

Descriptors: *Systems analysis, *Decision making, *Methodology, Operations research, Management, Social aspects, Political aspects, Institutional constraints.
Identifiers: *Policy, Bureaucratic structures.

This article provides insight into the limitations of systems studies and the manner in which policymakers use these studies. Three major themes are discussed. First, in systems studies the self-imposed limitation of playing down the broader political factors is defensible up to a point in the attempt to deal with a critical portion of the overall problem. Starting with the accepted 'political wisdom' may so corrupt the analysis that one never understands some of the fundamentals. Second, the chief difficulties arise in the transition from these 'suboptimized' analytical studies to decision making. In this respect analysts may have been remiss in failing to appreciate the crucial role of bureaucratic structures. Third, all important system studies--even when stated to be limited and 'suboptimized'--inevitably incorporate a number of non-technical assumptions, though typically in a tangential and implicit fashion. Without careful examination of the non-technical factors, adopting the conclusions of such specialized studies may be detrimental to policy. (Davis-Chicago)
W70-05437

A WATER BALANCE CONTROL-THEORETIC MODEL FOR REGIONAL MANAGEMENT,
British Columbia Univ., Vancouver; and Aria-Mehr University, Tehran (Iran).
Gary R. Gates, and Morteza Anvari.
Geographical Analysis, Vol 2, No 1, January 1970, p 19-29, 1 fig, 6 ref, 1 append.

Descriptors: *Management, *Methodology, *Planning, Water resources, Costs, Economic efficiency, Evaluation, Hydrologic aspects, Water balance.
Identifiers: *Control-theoretic model, *Water resource management, Cost effectiveness.

In response to the need for improved management methodology for politically-bounded regions such as provinces and states, a control-theoretic model for minimizing the cost of making desired hydrologic changes is outlined. The model is based on the premise that physical-hydrological processes within a region and cost-effectiveness of possible changes can be estimated with sufficient accuracy for systematic treatment. Several features are noteworthy in the model: (1) it incorporates the notion of the water balance on a systematic basis, (2) the decision maker specifies the state to be attained, (3) the model incorporates both the physical changes in quantities of water and the economic costs of making the changes, and provides a means for realizing desired objectives at least cost, (4) few unreasonable conditions are required for a solution, and (5) the model is conceptually simple and falls within a developed field of mathematics. It is concluded that a control theoretic model of the form: $dy(t)/dt = P(t)y(t)+Q(t)x(5)$, might eventually be a useful tool for managing water resources. However, before this will be possible, a means for establishing the functions must be developed and demonstrated. (Davis-Chicago)
W70-05438

SCIENCE AND THE CITY: THE QUESTION OF AUTHORITY,
Library of Congress, Washington, D.C. Legislative Reference Service.
James D. Carroll.
Science, Vol. 163, 28 February 1969, p. 902-911, 1 tab, 89 ref.

Descriptors: *Research and development, *Planning, *Institutional constraints, Social aspects, Political aspects, Governments.
Identifiers: *Metropolitan water resources management, *Urban programs.

An important aspect of urban programs is the problem of water resources development. Insights into this problem are provided by a discussion of the social authority and social relevance of public science and technology as it relates to the HUD research and development programs. Authority depends largely upon the capacity of an individual or an organization to satisfy expectations and values. However, the needs of modern society have resulted in a science based authority of knowledge which frequently supersedes the traditional authority of tradition and law. Accordingly, in many areas of government responsibility, science and technology have served to increase governmental effectiveness. However, this is not true of urban development where the lack of research traditions relating to urban development and the uncertainty over the meaning of 'urban science and technology' and 'urban research and development'. The HUD reaction is a research and development effort attempting to relate processes of law and government to processes of science and technology for the purposes of urban development. If successful, it should increase the effectiveness of legal and governmental action in urban areas. (Davis-Chicago)
W70-05441

A MULTISTRUCTURAL DEMAND MODEL FOR WATER REQUIREMENT FORECASTING (FINAL REPORT),
Oklahoma Univ., Norman. Bureau of Water Resources Research.
For primary bibliographic entry see Field 06D.
W70-05461

6B. Evaluation Process

A CRITERION FOR APPRAISAL OF ECONOMIC DEVELOPMENT PROJECTS,
California Univ., Los Angeles.
Fereidoun Mobasheri.
Eng Econ, Vol 15, No 1, p 9-27, Oct-Nov, 1969. 19 p, 31 ref.

Descriptors: Economics, *Benefit-cost ratios, Benefits, Value, *Social values, *Discount rate, Interest rate, Payment, Capital costs, Return (Monetary), *Economic feasibility, Bibliographies, *Foreign projects, Foreign countries, Capital, Evaluation, Appraisals, Synthesis, Labor, *Investment, Decision making.
Identifiers: *Developing countries, Operation and maintenance costs, Labor costs.

An economic evaluation criterion is synthesized for calculating the social benefit and cost of engineering projects in developing nations. The framework of the synthesized criterion is the concept of benefit-cost analysis. Modifications are accomplished so that national goals and important economic characteristics of developing countries are reflected in the decision making criterion. The modifications are made possible by introducing concepts such as the social rate of discount, the social opportunity cost of capital, the reinvestment of some portion of benefits from the project, and the shadow prices for production factors and products. (USBR)
W70-05220

TARBELA--THE LARGEST DAM IN THE WORLD.
For primary bibliographic entry see Field 08A.
W70-05244

THE ECONOMIC IMPACT OF DROUGHTS ON WATER SUPPLY SYSTEMS IN THE PASSAIC RIVER BASIN, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Meteorology.
For primary bibliographic entry see Field 02B.
W70-05275

ESTIMATING THE PRODUCTIVITY OF IRRIGATION WATER,
Hawaii Univ., Honolulu.
Howard C. Hogg, Lloyd B. Rankine, and Jack R. Davidson.
Agricultural Economics Research, Vol. 22, No. 1, pp. 12-17, Jan. 1970, 6 p, 2 fig, 3 tab, 8 ref.

Descriptors: *Irrigation efficiency, *Productivity, Agronomy, Water costs, Water demand, Regression analysis.
Identifiers: *Production function, Short-run cost curves, Product supply curves.

Known agronomic relationships are incorporated in a production function estimated from field records of two Hawaiian sugar plantations which use sugarcane irrigation. An equation is developed to estimate the water-yield relationship for sugarcane. A hypothetical relationship between yield and soil moisture is examined. An empirical example is included. The conclusion states that when production functions are estimated from yield records, the incorporation of known agronomic principles can lead to improved estimates. The production function is used to estimate optimum irrigation level as a function of water cost, a static factor demand relationship for irrigation water, short-run cost curves, and product supply curves. (Grossman-Rutgers)
W70-05282

THE VALUE OF INLAND WATERFRONT INDUSTRIAL SITES,
Illinois Univ., Urbana. Dept. of Geography.
David M. Solzman.
Land Economics, Vol. 45, No. 4, pp 456-462, Nov. 1969. 7 pp, 5 fig, 3 tab, 3 ref.

Descriptors: *Property values, *Sites, Industrial plants, Recreation.
Identifiers: *Chicago.

The assumption that waterfront sites for urban industries are a necessity and that such sites should be reserved for industries which exhibit a distinctive water orientation, is examined. The area investigated is the city of Chicago, the south branch of the Chicago River, and the in-city and near-city portions of the Chicago Sanitary and Ship canal. At present, only one-half of the establishments sited along the waterway make direct use of it. Of those that do use the waterway, almost all use it for transportation, the highest-value use according to the executives of waterway firms. The findings indicate a declining trend of direct waterway usage. The conclusion states that the best development for close-in, riverport lands may well be for parks and recreational uses to enhance the image of the central city and upgrade the amenities and quality of life in this area. (Grossman-Rutgers)
W70-05284

POLUTION AND POVERTY: THE STRATEGY OF CROSS-COMMITMENT,
For primary bibliographic entry see Field 05C.
W70-05285

ECONOMIC AND SOCIAL IMPACT OF RECREATION AT RECLAMATION RESERVOIRS
Denver Research Inst., Colo., Industrial Economics Div.
J. Gordon Milliken, and H. E. Mew, Jr.
Available from the Clearinghouse as PB-188 544, $3.00 in paper copy, $0.65 in microfiche. Mar 69, 216 p., 9 figs, 33 tabs, 220 refs. Prepared for the Bureau of Reclamation.

Descriptors: *Economics, *Colorado, *Dams, *Recreation, Reviews, Rural areas, Social impact, Economic impact, Cities, Recreation demand, Recreation facilities, Reservoirs, Water reports, Expenditures, Land development, Tourism.
Identifiers: Shadow Mountain reservoir, Granby reservoir, Horsetooth reservoir.

Three reclamation reservoirs in Colorado were studied, twenty years after construction, to determine the economic and social impact of recreation. Two were remote scenic mountain reservoirs (studied as a single area); the third was a foothills reservoir near a city of 40,000 population. Methodology included questionnaires and interviews with recreationists and businessmen, and analysis of land value changes. Substantial direct economic impacts are discussed for both reservoir areas. Socio-cultural impact also was studied and significant differences are noted between typical groups of recreationists using the two reservoir areas.
W70-05312

A WATER BALANCE CONTROL-THEORETIC MODEL FOR REGIONAL MANAGEMENT,
British Columbia Univ., Vancouver; and Aria-Mehr University, Tehran (Iran).
For primary bibliographic entry see Field 06A.
W70-05438

WATER QUALITY MANAGEMENT: FIRST ANNUAL REPORT.
Miami Conservancy District, Dayton, Ohio. Water Conservation Subdistrict.

Dayton, Ohio, Miami Conservancy District, August 1969. 97 p, 31 fig, 17 tab, 5 map.

Descriptors: *Planning, Water quality control, Regional analysis, Water utilization, *Project planning, Project life, Streamflow, Water quality, Sampling, Ecology, Data processing, Computers, Model studies, Waste assimilative capacity.
Identifiers: Great Miami River, Water quality standards, Surveillance, Alternative programs.

This report represents the Official Plan, Phase One, of the Water Quality Management Program being carried out by the Miami Conservancy District. This plan is an action program directed toward implementing a regional system which will protect and enhance uses of the Great Miami River. Section 3 introduces the program, discusses related programs of other agencies, and describes advisory groups. Section 4 describes the Water Quality Standard adopted by the Ohio Water Pollution Control Board. The Standard defines water quality goals for the Great Miami River and the means and schedule for attaining them. Section 5 discusses streamflow and observed water quality conditions of the river. Section 6 summarizes the activities carried out by the District in 1968: (1) sampling network; (2) cooperative sampling programs; (3) surveillance program; (4) ecological studies; (5) data processing and computer usage; (6) stream quality models; (7) evaluation of specific alternatives; (8) projection of waste loads; and (9) systems analysis. Section 7 discusses caretaking activities at levees, channels, and dams. Section 8 describes the personnel and consultants engaged in programs of the District. Section 9 gives a list of selected reports and memoranda. (Gossen-Chicago)
W70-05440

A MULTISTRUCTURAL DEMAND MODEL FOR WATER REQUIREMENT FORECASTING (FINAL REPORT),
Oklahoma Univ., Norman. Bureau of Water Resources Research.
For primary bibliographic entry see Field 06D.
W70-05461

MARGINAL VALUE OF IRRIGATION WATER AND A CASE STUDY OF TRANSFER IN SOUTHEASTERN WYOMING,
Wyoming Agricultural Experiment Station, Laramie.
For primary bibliographic entry see Field 03F.
W70-05462

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DETERMINING RATE OF RETURN BY MEANS OF PAYBACK PERIOD AND USEFUL LIFE,
San Jose State Coll., Calif.
Donald G. Newnan.
Eng Econ, Vol 15, No 1, p 29-39, Oct-Nov, 1969. 11 p, 6 fig, 11 ref.
Identifiers: Engineering economy, Analytical method.

The payback period is an important and widely used measure of the economic attractiveness of an investment opportunity. The concept is easy to understand and is readily computed by several methods, but these methods give misleading results. Nevertheless, payback period determination may be considered an effective intermediate step in computing the after-tax rate of return. Conversion techniques must be simple to encourage the use of rate of return as the decision criterion rather than payback period. The relationships between payback period and rate of return are developed for before-tax and after-tax situations. If the tax consequences are to be considered, the tax rate and depreciation method must be known in addition to payback period and useful life. The equations derived for computing the rate of return are plotted for selected values of the parameters; the resulting curves provide a simple means for determining the rate of return when the payback period is known. (USBR)
W70-05219

6D. Water Demand

WATER CONSUMPTION STATISTICS IN THE TEXTILE INDUSTRY WITH SPECIAL REFERENCE TO THE FINISHING INDUSTRY,
For primary bibliographic entry see Field 05G.
W70-05130

REPORT UPON ADEQUATE WATER SUPPLY FOR THE CHICAGO METROPOLITAN AREA--1969 TO 2000,
Alvord, Burdick and Howson, Chicago, Ill.
D. E. Eckman, and L. R. Howson.
September 1969. 235 p, 38 fig, 39 tab.

Descriptors: *Water demand, *Water supply, *Water resources, *Water works, *Water distribution, *Municipal water, *Cities, *Lake Michigan, *Planning, *Construction costs, Engineers estimates, Construction, Water rates.
Identifiers: *Chicago Water Works, *Chicago Department of Water and Sewers.

The report is a detailed account of an engineering investigation of water service requirements, and the costs of facilities required in meeting anticipated demands upon the Chicago Water System, to the year 2000. Chicago presently withdraws 4 million tons of water per day from Lake Michigan, purifies it in the world's two largest filtration plants, and delivers it through several thousand miles of tunnels and water mains to nearly five million persons in Chicago and 72 suburban communities. The engineers estimated that the population served by the year 2000 will be 6,105,100, in Chicago and 94 outlying communities. The average daily pumpage requirement will probably increase from 1,024 MGD in 1968 to 1,298 MGD by the year 2000. The two filtration plants will be adequate; however, pumping facilities, tunnel conduits, and feeder mains must be provided. The total capital required, at 1969 prices, to the year 2000 is $370,432,000. Of this, $104,266,000 is included in the present 5-year Water Works Capital Improvement Program (1969-1973). Additional capital requirements for new facilities between 1970 and 2000 is estimated at $58,266,000; and replacements and rehabilitation at $207,900,000. If built progressively, to the year 2000, anticipated expenditures are estimated at $633,255,000. An increase in water rates is considered necessary to meet current costs of operation and to provide funds for new construction. (Poertner-Chicago)
W70-05255

CHARACTERISTICS OF SUPPLY AND DEMAND IN OUTDOOR RECREATION,
Economic Research Service, Washington, D.C.
Hugh A. Johnson.
Agricultural Economics Research, Vol. 22, No 1, pp. 18-23, Jan. 1970. 6 p, 1 tab, 6 ref.

Descriptors: *Recreation demand, Access routes, Recreation facilities.
Identifiers: *Recreation supply.

Most studies in outdoor recreation are actually user studies. Ten categories of outdoor recreation cover 90 percent of the preferences. Each category has unique demand limitations and unique spatial requirements. A main factor of demand is that people have to travel to outdoor recreation locations. The supply of outdoor recreation depends partially on the limitations that someone usually must provide access, develop facilities, and provide services. Private enterprise will supply outdoor recreation facilities where the opportunities are the best, such as in or near densely populated areas. Opportunities for private enterprises weaken as dependence on services and facilities decreases. (Grossman-Rutgers)
W70-05281

THE NATION'S WATER RESOURCES (REVIEW ARTICLE),
Wisconsin Univ., Madison. Dept. of Urban and Regional Planning.
Irving K. Fox.
Land economics, vol. 45, No. 4, pp. 474-476, Nov. 1969. 3 pp, 6 ref.

Descriptors: *Assessments, Water supply water resources planning act.
Identifiers: *Water resources council.

A brief history leading to the publication of the report, the Nation's Water Resources, is given. Six difficult conceptual and analytical problems are presented: (1) In view of the high cost, relative to value, of transporting water, what is the market area for which a given supply is relevant. (2) How are differences in quality to be taken into account. (3) How is demand to be measured when so many uses are not priced or are marketed at subsidized prices. (4) What is the relevant measure of use. (5) For withdrawal uses alone, what is the measure of use and in particular what account is to be taken of the return flow which for most uses is very large. (6) Finally, there is present the hazards of projecting into the future on a regional basis in the face of rapidly changing technological, economic, and social conditons. The ability of the report made by the Water Resources Council to overcome these problems is examined. (Grossman-Rutgers)
W70-05283

A MULTISTRUCTURAL DEMAND MODEL FOR WATER REQUIREMENT FORECASTING (FINAL REPORT),
Oklahoma Univ., Norman. Bureau of Water Resources Research.
George W. Reid.
Available from the Clearinghouse as PB-190 813, $3.00 in paper copy, $0.65 in microfiche. Oklahoma University Research Institute Project 1626, Final report to Office of Water Resources Research, January 1970. 236 p, 27 fig, 25 tab, 73 ref, 2 append. OWRR Project C-1023 (No 1574).

Descriptors: *Water demand, *Water supply, *Water resources development, *Systems analysis, *Optimization, Computer programs, Water utilization, Water systems, Model studies, Mathematical models, Statistical models, Economics, Social aspects.
Identifiers: Water demand model.

A 'people needs' mathematical model, multistaged, multivariant, or multistructured and fully computerized was developed to forecast future water requirements. The economic model for projecting municipal sector requirements will provide public, private, and service sector needs under various life style goals for either possible or probable worlds articulated over time and adjustable to revised goals. The model has a national base using resource concepts. The basic model uses both demographic and economic imputs and provides, through shift analyses, adjudicated sector outputs. The economic model is adaptable to a variety of technical models or procedures to produce municipal and industrial water requirements. The model has been used on a major city, it is completely computerized, and can be easily used for other essential services such as sewage, storm water, transportation, housing, etc. On regional or basin bases, irrigation, municipal, power, and other uses of water can be balanced. This flexible demand model can be used as a tool on a wide variety of supply-demand studies. (Knapp-USGS)
W70-05461

MINERAL AND THERMAL WATERS OF BELGIUM (FRENCH),
For primary bibliographic entry see Field 02F.
W70-05488

6E. Water Law and Institutions

WATCH BOATS.

Del Code Ann tit 7, secs 2701-2706 (Supp 1966).

Descriptors: *Delaware, *Boats, *Commercial shellfish, *Regulation, Oysters, Permits, Beds, Conservation, Legislation, State governments, Jurisdiction, Control, Dredging, Commercial fishing.
Identifiers: *Watch boats, *Law enforcement, Crimes, Trespass, Boat crews, Legal actions, Wardens, Penalties (Criminal).

Enforcement of shellfish laws and protection of oyster beds shall be accomplished by watch boats. The boats shall cruise over oyster plantations and natural beds for the purpose of preventing depredation by trespassers. On board each watch boat shall be a list of licensed oyster planters, dredgers and crew members of each dredge. If any person resists the crew of a watch boat, he shall be fined or imprisoned and fined, depending on whether life is endangered or lost in such resistance. If life is taken by the resisting party, he is guilty of murder in the first degree. The boat crews may use any force necessary to enforce the law, and may plead their duties under this title as a defense in any criminal or civil action against them. Upon command of the person in charge of the watch boat, any other boat shall aid in seizure of boats, crew members, and everything on any vessel used in violation of this title. On the Broadkiln and Mispillion rivers a suitable watch boat shall be used with a warden and other necessary persons on board. Wardens and other crew members shall be appointed by the Governor and shall meet residence requirements of this statute. (Harris-Florida)
W70-05222

HARBORS AND NAVIGATION (BOARDS OF HARBOR COMMISSIONERS).

Wis Stat Ann secs 30.37, 20.38 (1964).

Descriptors: *Wisconsin, *Harbors, *Administrative agencies, *Cities, Navigable waters, Public health, Safety, Planning, Administration, Ships, Construction, Leases, Maintenance, Docks, Railroads, Airports, Boats, Marinas, Transportation, Bridges, Cost allocation, Supervisory control (Power).
Identifiers: *Commercial aspects.

Any municipality situated on a navigable waterway may create a board of harbor commissioners. Once created, the board is largely independent of the municipality which created it. The powers and duties of such a board shall include: (1) operation of publicly-owned wharf and terminal facilities; (2) leasing of publicly-owned harbor lands or facilities to any party; (3) assignment of berths and maintenance of guards at publicly-owned harbor facilities; (4) operation of municipal airport facilities contiguous to the harbor area; (5) operation of municipal harbor craft such as fireboats and tugs; and (6) general planning to improve the harbor for public purposes. The boards shall be funded and their expenditures accounted for as prescribed by statute. (Dearing-Florida)
W70-05241

CITIES AND VILLAGES ACT (ACQUISITION OF PUBLIC BEACHES).

Ill Ann Stat ch 24, sec 21-18 (Smith-Hurd 1962).

Descriptors: *Illinois, *Recreation facilities, *Local governments, *Land use, Beaches, Cities, Water resources development, City planning, Shores, Legislation, Project planning, City planning.

The city of Chicago may acquire municipal parks, play grounds, public beaches, and bathing places and improve, maintain, and regulate the same. (Hubener-Florida)
W70-05243

RELINQUISHMENT OF CLAIMS AND ISSUANCE OF PATENTS TO CERTAIN REAL ESTATE.
Ind Ann Stat sec 62-401 (1962).

Descriptors: *Indiana, *Patents, *Real property, *Riparian land, Legislation, Legal aspects, Land, Land tenure, Rivers, State governments.

The Governor is authorized and directed to issue patents to certain described real estate bordering the Little Calumet River. (Powell-Florida)
W70-05248

MOSQUITO CONTROL (MOSQUITO EXTERMINATION COMMISSIONS).
Pa Stat Ann tit 16, secs 11854, 11855 (1956).

Descriptors: *Pennsylvania, *Mosquitoes, *Aquatic insects, *Insect control, Administrative agencies, Insecticides, Insects, Larvicides, Larvae, Public health, Breeding, Abatement, Cost repayment, Assessments, Water supply, Cities, Legal aspects, Legislation.
Identifiers: *Public nuisance.

Each county mosquito extermination commission shall have the power to eliminate all mosquito breeding places on public or private property and may enter such property and do all necessary acts for the elimination of such breeding places. Any water in which mosquito larvae breed is declared to be a public nuisance and must be abated by the owner or, if the owner fails to abate the nuisance, by the commission. The cost of such abatement may be assessed against the landowner. No order of abatement shall in any way affect any waters used or reserved for the supply of water to the public, whether by a municipality or by a water company. (Dearing-Florida)
W70-05301

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME I: INTRODUCTION, CHAPTERS 1 AND 2.
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 714, $3 in paper copy, 65 cents in microfiche. Nov 69, 289 p.

Descriptors: *Continental shelf, *Economics, Planning, Natural resources, International law, Fish, Industries, Sulfur, Water pollution, Pipes, Atlantic Ocean, Pacific Ocean, *Legislation, Mineralogy, Oil, Gulf of Mexico, Fisheries, Pipelines, Public lands.

Contents: Introduction; Legal aspects (International considerations. Allocation of federal jurisdiction over activities on or affecting the outer continental shelf. Background of the Submerged Lands Act and Outer Continental Shelf Lands Act, Administration of the Outer Continental Shelf Lands Act); Resource aspects (Known and potential resources of the outer continental shelf, Living resources of the continental shelf, Anticipated

development of offshore mineral industry and technology, Economic analysis of leasing experience under the Outer Continental Shelf Lands Act, An economic analysis of prorationing of production). (See also W70-05307).
W70-05306

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME II: (CHAPTERS 3 THROUGH 7).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 715, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 336 p.

Descriptors: *Continental shelf, *Economics, Natural resources, Standards, Drilling, Fish, Industries, California, Texas, Louisiana, *Legislation, Minerology, *Public lands, Beds, Oil.

Contents: Background of the submerge lands act and outer continental shelf lands act; Administration of the outer continental shelf lands act; Living resources of the continental shelf; Anticipated development of offshore mineral industry and technology. (See also W70-05308)
W70-05307

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME III: (CHAPTERS 8 THROUGH 12).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 716, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 249 p.

Descriptors: *Continental shelf, *Economics, Gases, Natural resources, Planning, Drilling, Standards, Louisiana, *Legislation, Oil, Mineralogy, Gulf of Mexico, Seashores, *Leases.

Contents: Economic analysis of leasing experience under the Outer Continental Shelf Lands Act; An economic analysis of prorationing of production; User interaction and environmental impact; Analysis of the existing system of administration of outer continental shelf lands; Analysis of alternatives to existing system. (See also W70-05309)
W70-05308

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME IV: (APPENDICES).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott Krueger, and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 717, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 397 p.

Descriptors: *Continental shelf, *Economics, Natural resources, Drilling, Sulfur, Gases, Shales, Deep water, Manganese, Hawaii, California, Texas, Louisana, Alaska, Oregon, *Legislation, Mineralogy, Oil, Exploration, Public lands, Leases, Gases.

Contents: Truman proclamation; Convention on the continental shelf; Convention on the territorial sea and the contiguous zone; Convention on the high seas; Convention on fishing and conservation of the living resources of the high seas; Public law 89-658; 80 Stat. 908 fishery zones--extra-territorial sea; Marine Resources and Engineering Development Act of 1966; A discussion of the legislative history and possible construction of the Convention on the Continental Shelf; U.N. resolution establishing the Ad Hoc Committee to study peaceful uses of the sea-bed and the ocean floor beyond the limits of national jurisdiction; Proposal of the permanent Mission of Malta; Draft resolution of United States to Ad Hoc Committee; Submerged Lands Act; Outer Continental Shelf Lands Act; Regulations - Bureau of Land Management; Regulations - U.S. Geological Survey; Exchange of correspondence between the Department of the Interior and the Department of the Army regarding review of applications for permits; Potential Mineral Resources of the United States Outer Continental Shelf; Report of the Secretary General to the United Nations Economic and Social Council on the Resources of the Sea. (See also W70-05310)
W70-05309

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES, VOLUME V (APPENDICES).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 718, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 399 p.

Descriptors: *Continental shelf, Gases, Natural resources, Planning, Bibliographies, California, Louisiana, Texas, Alaska, Oregon, Hawaii, *Legislation, Mineralogy, Leases, *Public lands.

Contents: Bibliography and source list; Questionnaire to industries; Notices concerning oil and gas leasing; Summaries of salt water angling and collisions involving offshore structures; Work statement; Comparative laws and policies (domestic). (See also W70-05311)
W70-05310

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES, VOLUME VI: (APPENDICES).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 719, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 220 p.

Descriptors: *Continental shelf, *Economics, Natural resources, Standards, Alaska, California, Louisiana, Oregon, Texas, *Legislation, Mineralogy, Cost analysis, *Leases, *Public lands.

Contents: Offshore mineral leasing experiences of coastal states; Comparitive laws and policies (foreign); Compilation of alternatives; Department of the Interior reports. (See also W70-05306)
W70-05311

THE CONSTITUTIONALITY OF EFFLUENT CHARGES,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W70-05320

APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY,
For primary bibliographic entry see Field 05A.
W70-05332

THE OCEANS' RESOURCES AND INTERNATIONAL LAW-POSSIBLE DEVELOPMENTS IN REGIONAL FISHERIES MANAGEMENT,
Loyola Univ., Los Angeles, Calif. School of Law.
L. F. E. Goldie.
Columbia Journal of Transnational Law, Vol 8, No 1, p 1-53, Spring 1969. 53 p.

Descriptors: *Law of the sea, *Resource development, *Commercial fishing, *International waters, Legal aspects, Fish conservation, Fish control agents, Fishing, Fish management, Marine fisheries, Regulation, Legislation, Oceans, Continental shelf, International law, Treaties, Regime.
Identifiers: Maximum sustainable yield.

The traditional approach of international law to the use of the seas for fishing divides the seas into two categories: those under the sovereignty of a coastal state and the 'free high seas,' beyond the sovereignty of any state. Marine resources of the high seas are common property, open to the first man who can reduce them to his effective possession. This law of the sea is based on the assumption that the oceans' resources are inexhaustible and all may freely fish without causing detriment to others. The need for international cooperation in exploiting and conserving high seas' fishing must foster original approaches to man's legal relations to the sea. Regional fishery regimes with authority to give economic direction and pursue conservation goals are suggested to enhance exploitation of marine fisheries. The facilities offered by the Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas are analyzed towards this end. Various forms of managerial approaches and criteria for granting access to marine resources are examined. The multinational public enterprise is recommended as an alternative to traditional legal concepts to resolve international fisheries disputes. (Cuevas-Florida)
W70-05333

REASONABLE STATE REGULATION OF THE INTERSTATE TRANSFER OF PERCOLATING WATER,
Cornell Univ., Ithaca, N.Y. School of Law.
Michael D. White.
Natural Resources Lawyer, Vol 2, No 4, p 383-406, Nov 1969. 24 p. OWRR Project A-006-NY.

Descriptors: *Percolating water, *Hydrologic cycle, *Interstate compacts, *Water management (Applied), Underground streams, Well permits, Well regulations, Regulation, Legislation, State governments, Federal government, Subsurface flow, Subsurface waters, Aquifers, Surface waters, Legal aspects, Judicial decisions, Riparian rights, Reasonable use, Prior appropriation, Water pollution, Geohydrologic units, Groundwater, Hydrogeology, Water transfer.

Significant problems of water supply result in the transfer of substantial quantities of water between states. Although the federal government has not acted, the inequality of water supply existing between states indicates the need of an integrated national approach to the problem. The states have a protective interest regarding their water supply and legislate anti-export statutes to provide conservation of this resource. This may be in violation of the Commerce Clause when viewing water as an article of commerce. Cases construing this point are discussed. There are five types of percolating water jurisdiction. They are those adhering to the: (1) absolute privilege doctrine; (2) Forbell version of the reasonable use doctrine; (3) the Restatement of Torts version of the reasonable use doctrine; (4) the correlative rights doctrine; and (5) a statutory version of the prior appropriation doctrine. The validity of anti-export statutes is demonstrated by examining the statute of one state in each type of percolation jurisdiction. In proposing state non-discriminatory protective legislation based on valid conservation ideas, it is concluded that the reasonableness of anti-export statutes is uncertain as a violation of the Commerce Clause. (Barnett-Florida)
W70-05334

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE,
For primary bibliographic entry see Field 04B.
W70-05335

PROJECT GROUNDWATER PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGAL RIGHTS TO GROUNDWATER),
For primary bibliographic entry see Field 04B.
W70-05336

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-EXCESS LANDOWNER PROBLEM),
For primary bibliographic entry see Field 04B.
W70-05337

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE EXCESS LANDOWNER PROBLEM),
For primary bibliographic entry see Field 04B.
W70-05338

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-PROJECT LANDOWNER PROBLEM),
For primary bibliographic entry see Field 04B.
W70-05339

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGISLATIVE PROPOSALS),
For primary bibliographic entry see Field 04B.
W70-05340

RURAL WATER DISTRIBUTION SYSTEMS: AN ANALYSIS OF CREATING A LOCAL SYSTEM,
William L. Latham.
Mississippi Law Journal, Vol 40, No 3, p 425-438, May 1969. 14 p, 1 append.

Descriptors: *Rural areas, *Project planning, *Water distribution (Applied), *Government finance, Mississippi, Distribution systems, Public utilities, Federal government, Water resources development, Legal aspects, Federal project policy, Regulation, Legislation, Programs, Project purposes, Costs, Financing, Loans, Grants, State governments, Community development.
Identifiers: Farmers Home Administration.

The availability of federal funds necessary to establish a rural water system is examined with emphasis on the Farmers Home Administration program. Federal assistance requirements and guidelines governing funds distributed through FHA for rural water projects are analyzed in detail. Such aspects as source and types of funds available, development cost of the project, definition of rural area, and problems of preliminary design are discussed. It is suggested that a general construction plan and customer survey for the proposed service area be submitted to demonstrate the project's conformity to community development. Mention is made of Mississippi's experience in obtaining FHA funds. The Mississippi Public Service Commission has jurisdiction over water distribution systems. Procedural requirements necessary to obtain permission to construct and operate a rural water system are listed. An appendix contains a sample petition for a certificate of convenience and necessity. Rural water associations are subject to rate regulation unless their officers are elected by consumers or appointed by the county board of supervisors. Regulation of all water systems' services remain under the Commission. (Cuevas-Florida)
W70-05341

LEGAL CONTROL OF WATER POLLUTION.
For primary bibliographic entry see Field 05G.
W70-05342

STATE CONTROL OF WATER POLLUTION: THE CALIFORNIA MODEL.
For primary bibliographic entry see Field 05G.
W70-05343

WATER POLLUTION CONTROL THROUGH INTERSTATE AGREEMENT.
For primary bibliographic entry see Field 05G.
W70-05344

FEDERAL PROGRAMS FOR WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 05G.
W70-05345

SPECIAL PROBLEMS OF WATER POLLUTION: THE PRIVATE SECTOR.
For primary bibliographic entry see Field 05G.
W70-05346

POLLUTION OF GROUNDWATER.
For primary bibliographic entry see Field 05G.
W70-05347

POLLUTION OF THE SEA.
For primary bibliographic entry see Field 05G.
W70-05348

SAN JOAQUIN DELTA: IS NEGOTIATION A SOLUTION.
For primary bibliographic entry see Field 05G.
W70-05349

ESTABLISHMENT OF STATE, COUNTY, AND CITY BRIDGE COMMISSIONS.

Ohio Rev Code Ann secs 5593.01 thru 5593.19 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Bridges, *Bridge construction, *Administrative agencies, Legislation, Legal aspects, Political aspects, Local governments, Taxes, Navigation, Rivers, Navigable waters, Eminent domain, Condemnation, Right-of-way, Construction costs, Highways, Supervisory control (Power), State governments, Jurisdiction, Financing.

The State Bridge Commission of Ohio is created and authority is granted to counties and cities to establish local bridge commissions. These commissions may: (1) construct, acquire by purchase or condemnation, maintain, and operate any bridge; (2) issue bridge revenue bonds; (3) fix and collect tolls; (4) acquire by purchase or condemnation any property or rights in property necessary or convenient for the construction, improvement, or efficient operation of a bridge, or for securing rights-of-way leading to bridge approaches. The Director of Highways must approve all bridge commissions. Procedures for the issuance and funding of bridge revenue bonds are enumerated. (Casey-Florida)
W70-05357

ILLINOIS-MISSOURI BRIDGE COMMISSION.
Mo Ann Stat secs 234.430 thru 234.490 (Supp 1970).

Descriptors: *Missouri, *Interstate compacts, *Bridge construction, *Interstate commissions, Illinois, Mississippi River, Interstate rivers, Construction, Maintenance, Planning, Financing, Bridges, Costs, Contracts, Condemnation, Structures, Regulation, Easements, Administrative agencies, Legislation, Legal aspects, Supervisory control (Power), Operation and maintenance.
Identifiers: *Ferries, Bonds, Tolls.

The Governor, with the advice and consent of the senate, will appoint three commissioners to enter into a compact with Illinois. The Illinois-Missouri Bridge Commission is created with the following powers and duties: (1) to plan, construct, maintain and operate a bridge across the Mississippi River at or near Canton, Missouri; (2) to purchase, maintain and operate any or all ferries across the Mississippi River within twenty-five miles of the bridge; (3) to contract and acquire property by condemnation or otherwise; (4) to issue bonds for the payment of the costs of the bridge, ferries, and necessary property on the security of the revenues derived from the operation of the bridge and ferries; (5) to establish and charge tolls for transit over such bridge and ferries; and (6) to perform all other necessary and incidental functions. Toll rates will be charged to provide funds sufficient to pay for maintenance, repairs, and operation of the bridge, and to pay the principal and interest on outstanding bonds. The administrative composition of the Commission is provided for. Upon the retirement of all bonds and the conveyance of title to the bridge to the states of Missouri and Illinois, the Commission will be dissolved. (Keith-Florida)
W70-05358

STATE V BILLIOT (CONFISCATION OF TRAWLS FOR ILLEGAL SHRIMP TRAWLING).

229 So 2d 72-76 (La 1969).

Descriptors: *Louisiana, *Shrimp, *Commercial fishing, *Trawling, Judicial decisions, Legislation, Legal aspects, Brine shrimp, Fishing, Nets, Wildlife, Wildlife conservation, Fish conservation, Oceans, Sea water, Marine fisheries, Administrative agencies, Fishing gear, Commercial shellfish, Wildlife management, State governments.
Identifiers: Confiscation, Penalties (Criminal).

Defendants were found guilty in a jury trial of trawling in inside waters for salt water shrimp during the closed season. The trial court, after sentencing the defendants, suspended sentence and ordered the Louisiana Wildlife and Fisheries Commission to return the trawls that had been seized at the time of the arrest. The state sought a writ of certiorari to contest the action of the trial court, contending that the Louisiana statute made the jail sentences and confiscation of equipment mandatory. The Supreme Court of Louisiana granted certiorari and reversed the trial court, holding that the general statute relating to the suspension of sentences for misdemeanors was not applicable to statutes making sentences mandatory. Defendants' contentions that the trawling statute was vague, violated due process, and constituted cruel and inhuman punishment were rejected by the court. The court held that the state has the power to deter the violation of its fish and game laws by the forfeiture of the equipment used in the illegal taking of such fish and game. (Schram-Florida)
W70-05359

COOK v WEINBERGER BUILDERS INC. (RIGHT OF ACCESS OVER PRIVATE EASEMENT ON PRIVATE LAND).

172 N W 2d 876-878 (Ct App Mich 1969).

Descriptors: *Michigan, *Access routes, *Easements, *Lakes, Judicial decisions, Right-of-way, Real property, Relative rights, Legal aspects, Land tenure, Land use, Water rights.

Both plaintiff and the individual defendants were lot owners in a subdivision. The subdivision contained a private lake dedicated to the use of certain owners with a twenty-foot private easement around the lake reserved for the use of public utilities. The easement gave the defendant lot owners access as far as the twenty-foot private easement, but to reach the lake, the final twenty feet had to be crossed. Defendants crossed this twenty feet over the land of the plaintiffs. Plaintiff's complaint was

dismissed by the trial court. The appellate court held that the dismissal was improper since the trial court failed to make findings of fact and to state its conclusions of law to support a judgment that the lot owners had access to the water over the private easement on plaintiff's land. (Douberley-Florida)
W70-05361

FROST v STATE (CONSTITUTIONALITY OF USING PRIMARY ROAD FUNDS FOR INTERSTATE BRIDGES).
172 N W 2d 575-588 (Iowa 1969).

Descriptors: *Iowa, *Bridge construction, *Interstate, *Financing, Judicial decisions, Bridges, State governments, Rivers, Interstate rivers, Mississippi River, Government finance, Interest, Planning, Financial analysis, Taxes, Operating costs, Construction costs, Maintenance costs, Reimbursable costs, Legislation, Illinois, Legal aspects.
Identifiers: *Interstate bridges, Bonds, Tolls, Road funds.

Plaintiff challenged the constitutionality of the Interstate Bridge Act and sought to enjoin the construction of a bridge by the State of Iowa connecting Iowa and Illinois. The state supreme court held that the tax levied was not a violation of due process, and that proper procedures for the construction has been followed. It held, however, that the portion of the Act which allowed primary road funds to be used in the initial construction and maintenance of the bridge was unconstitutional. The state constitution specified that certain of the taxes that made up the primary fund be used exclusively within the state. Using these funds to finance portions of the bridge in another state was a constitutional violation. The court struck down a part of the Act which did not allow the powers of the highway commission to be diminished, since this would unlawfully bind future legislatures. It also held that the commission could not issue bonds to repay moneys used from the primary road fund because the Act provided for repayment from tolls only. The remaining sections of the Act were found to be separable from the unlawful provisions and remained in force. (Douberley-Florida)
W70-05363

DRAKE V TOWN OF BOONTON (ASSESSMENTS FOR CONSTRUCTION OF WATER MAIN).

106 N J Super 79, 254 A2d 151-155 (1969).

Descriptors: *New Jersey, *Pipes, *Local governments, *Repayment contracts, Water supply, Judicial decisions, Legal aspects, Water users, Pipelines, Construction, Water conveyance, Water delivery, Water demand, Legislation, Water costs, Conduits, Construction costs, Contracts, Cities.

Plaintiffs sought to compel defendant municipality to supply plantiffs with water. Plaintiffs lived on a street serviced by a water main constructed by a private individual pursuant to a contract with defendant that defendant would maintain and operate the pipe and the builders of the main would be reimbursed by collecting a proportionate share of such installation costs from those wishing to tie-in to the main. Plaintiffs refused to make such payment. The contract between defendant and the individual was valid under a statute that gave defendant discretionary power to build such main. However, by providing a reimbursement clause for the individual, defendant abdicated its function of collecting water rents to a private individual. This was illegal and the plaintiffs could not be forced to make a payment to the individuals who constructed the water main. Since the main was owned and controlled by the municipality, defendant was required to supply water to the plaintiffs and to reimburse the individual who built the main from revenues collected from those who tied into the main. (Barnett-Florida)
W70-05364

THE QUALITY OF THE ENVIRONMENT: A REVIEW,
Toronto Univ. (Ontario). Dept of Geography.
For primary bibliographic entry see Field 06F.
W70-05373

MAN, WATER, AND ENVIRONMENT,
Water Pollution Research and Applications, Inc., Washington, D.C.
For primary bibliographic entry see Field 05B.
W70-05384

RAILROADS-CONSTRUCTION AND OPERATION.

Iowa Code Ann secs 477.1-477.5 (1949).

Descriptors: *Iowa, *Railroads, *Engineering structures, Bridges, Roads, Highways, Navigation, Pipelines, Mississippi River, Missouri River, Channels, Legal aspects, Rivers, Riparian rights, Navigable rivers, Streams, Construction, Bridge construction, Road construction, Repairing, Shore protection, Piers, Coastal structures, Maintenance, Damages, Compensation, Legislation.

Any railroad company may build its railway across, over, or under any other railway, canal or watercourse whenever necessary. The company shall be liable for all damages caused by such crossing. The construction of such crossing shall not unnecessarily impede travel, transportation or navigation. All bridges, abutments or other construction used to cross over or under any watercourse, public highway or other railway must be kept in good repair. The railway company shall be liable for any damages sustained because of violation of this act. All riparian owners or lessees of land on the Iowa banks of the Mississippi or Missouri rivers are entitled to build all necessary adjuncts for the navigation of those rivers provided that such structures in no way impede navigation on those waterways. No railroad or other obstruction may be constructed between the riparian lots and the Mississippi and Missouri rivers unless the amount of injury to such property is ascertained and properly paid over to the owner or lessees of such damaged property. Any railway may lay and maintain pipes through any lands adjoining its tracks for 3/4 of a mile in order to conduct water for its engines from any running stream. (Barnett-Florida)
W70-05390

FEDERAL PROGRAMS RELATED TO ENVIRONMENT,
Library of Congress, Washington, D.C. Legislative Reference Service.
Elizabeth Boswell.
Washington: The Library of Congress Legislative Reference Service, 70-30 EP, TP 450, February 1, 1970. 72 p, 1 tab.

Descriptors: *Environment, *Federal government, *Administration, Institutions, Administrative agencies, Institutional constraints.

In recent weeks there has been a surge in activity in the Federal Government to set up new environmental administrative mechanisms, including some in-house reorganization of Federal departments. This report provides a compilation and brief description of the purposes, functions and activities of existing Federal agencies having programs which are significantly related to environmental concerns. Federal departments, independent agencies and selected boards, commissions and committees are included in the listing. (Davis-Chicago)
W70-05435

THE 'SOFT' FACTORS IN SYSTEMS STUDIES,
Rand Corp.
For primary bibliographic entry see Field 06A.
W70-05437

SCIENCE, VOTERS, AND THE FLUORIDATION CONTROVERSY,
Massachusetts Inst. of Tech., Cambridge.
Harvey M. Sapolsky.
Science, Vol 162, 25 October 1968, p 427-433. 2 tab, 50 ref.

Descriptors: *Fluoridation, *Social aspects, *Political aspects, Attitudes, Decision making, Public health.
Identifiers: *Voter behavior.

This examination of the fluoridation controversy attempts to illustrate more clearly the role of the citizen in a scientifically complex society. From this perspective, an analysis of the fluoridation controversy becomes a study in the relation between science and democracy. An analysis of studies of fluoridation campaigns suggests that the shift in opinion from positive to negative, is due to confusion that develops in the minds of the voters. The voters, although predisposed to favor fluoridation, are initially quite ill-informed about it. The public, believing the fluoridation issue to be a conflict among scientific experts, seeks the safest course. Unable to decide between what appear to be two contending scientific positions, the voters opt to avoid the greatest potential health risks by defeating the fluoridation proposals. This situation points to an important problem--what is the citizen's role in a society that seeks to be both scientifically advanced and democratic. Fluoridation seems to confirm the inappropriateness of direct citizen involvement in policy-making. The technical intracacies of the problem are too great for the average voter to resolve. Administrative agencies and legislatures, with their more deliberate procedures and their greater capacity to distinguish among experts, are more able to nationally consider questions of safety and efficacy. The need may be for new educational programs which would not train the citizens to be knowledgeable in the various fields of science, but rather would equip him to deal with scientific arguments and scientific experts, through understanding the limits and uses of science. (Davis-Chicago)
W70-05439

GAME, INLAND FISHERIES AND DOGS (STATE AND COUNTY FISHING LICENSES).

Va Code Ann secs 29-57 thru 29-60, 29-77.1 (1969).

Descriptors: *Virginia, *Fishing, *Permits, *Regulation, Water sports, Recreation, Legislation, Legal aspects, Water utilization, Trapping, Hunting, Wildlife, Water conservation, Tidal waters, Streams, Low water mark, Water types, Fish management, Water policy, Wildlife management, Fish conservation.
Identifiers: *Licenses, Penalties (Civil).

The persons entitled to county or state resident licenses to hunt, trap or fish are enumerated. Nonresidents are required to obtain a nonresident license. The residents of counties bordering a nontidal stream have the right to hunt, trap and fish in such stream opposite the shore line of the county for which such resident has a county license. The residents of counties bordering a tidal stream have such right to the low water mark or as far as the county limits of the county for which he has a license extends. Any person found guilty of violating any of the provisions of the hunting, trapping and/or inland fish laws twice within two years shall have his license by the court trying the case. (Powell-Florida)
W70-05446

FISHERIES AND GAME: STATE BOARD.

Conn Gen Stat Ann secs 26-18 thru 26-26 (1960), as amended, (Supp 1969).

Descriptors: *Connecticut, *Fish conservation, *Fisheries, *Fishing, Fish, Game birds, Administrative agencies, Boats, Boating, Regulation, Right-of-

way, Streams, Ponds, Forest fires, Fish management, Nutrient requirements, Fish diets, Legal aspects, Wildlife management, Animal control, Aquatic populations, Aquatic weed control, Legislation, State governments, Interstate.
Identifiers: *Fishing seasons.

It is unlawful to apply to the State Board of Fisheries and Game for any fish or game with the intent to use the same for purposes other than those stated in the application. Restrictions are placed on the use of boats in Bantam River. The Board shall erect signs to clearly indicate the location of rights-of-way to state ponds and streams. The Board may also remove any undesirable plants or animals from the waters of the state, or may add substances to the waters (subject to approval by the Department of Health) to increase the production of fish food organisms. The Governor may, when extraordinary measures are necessary to prevent forest fires, proclaim a closed season on sport fishing in inland waters. Such proclamation shall not apply to certain excepted areas. On waters lying between Connecticut and their respective states, officers of Rhode Island, Massachusetts and New York may enforce Connecticut fish and game laws. (Dearing-Florida)
W70-05447

PARK COMMISSIONERS.

Ill Ann Stat ch 105 secs 81 thru 85, 92, 94, 97, 98, 114 (Smith-Hurd 1952).

Descriptors: *Illinois, *Parks, *Local governments, Beds, Shores, Condemnation, Judicial decisions, Financing, Legislation, Construction, Contracts, Railroads, Reclamation, Docks, Harbors, Navigation, Cities, Canals, Levees, Piers, Riparian rights, Boundaries (Property).

The commissioners of Lincoln Park may acquire the riparian rights appurtenant to the shore lands and such submerged lands as are necessary to any plan for extension of the park. The new boundary lines may be established by proper suit in chancery. If the commissioners are unable to reach an agreement with the owners of the desired lands, then proceedings for condemnation may be instituted. The submerged lands thus acquired and the rights appurtenant thereto shall be held by the commission for the purpose of maintaining or extending the public park and facilities. The cost of such acquisition and construction may be paid out of general revenue or by interest bearing bonds. (Darragh-Florida)
W70-05449

LOCAL GOVERNMENT; LIMITATIONS ON INDEBTEDNESS.
Ill Ann Stat ch 85, secs 851.56, 851.17, 851.19 (Smith-Hurd 1966), as amended, (Supp 1970).

Descriptors: *Illinois, *Water resources development, *Water conservation, *Water management (Applied), Legislation, Legal aspects, Water utilization, Water supply, Flood control, Drainage, Sanitation, Navigation, Recreation, Ditches, Fish conservation, Channels, Water conveyance, Water control, Dams, Levees, Financing, Surface water, Sewers, Sewage treatment, Supervisory control (Power).

The river conservancy districts are organized under an act giving such districts the power to effectuate river and flood control, drainage, irrigation, conservation, sanitation, navigation, recreation, development of water supplies, and the protection of fish life. The surface water protection districts are organized for the purposes of acquiring, establishing, maintaining, and operating ditches, channels, flumes, or similar waterways or any other types of construction necessary for the collection of surface water within the district. The district is also formed to convey and dispose of such waters at suitable points of discharge. The statutory limitations of indebtedness do not apply to the river conservancy districts or the surface water protection districts. The limitations do not apply to any indebtedness for either acquiring, constructing, operating, or maintaining sewage facilities or sewage treatment plants incurred by any county under an act relating to water supply, drainage, sewage, pollution or flood control. (Powell-Florida)
W70-05450

INTERSTATE BRIDGES.
Iowa Code Ann secs 313A.1-313A.39 (Supp 1970).

Descriptors: *Iowa, *Bridges, *Bridge construction, *Administrative agencies, Highways, Civil engineering, Bridge design, Interstate rivers, Navigable rivers, Cities, Government finance, Financing, Condemnation, Right-of-way, Payment, Transportation, Operation and maintenance, Operating costs, Administrative costs, Construction costs, Maintenance costs, Cost sharing, Legislation, Legal aspects.
Identifiers: *Franchises.

The State Highway Commission may construct and acquire toll bridges as a part of any public highway across any navigable river between this state and an adjoining state. Such construction and acquisition is to be financed by the issuance of revenue bonds, by contributions from political subdivisions, and by tolls collected from the bridges. The Commission shall control the operation, maintenance and financing of these bridges and may also acquire rights-of-way to the bridges. Procedure is provided for determining the need for, and public interest in, establishment of a toll bridge in a particular location. Funding and expenditure provisions are also included. The Commission shall set the toll rate for all interstate bridges hereinfor provided. When it is deemed to be in the public interest, the Commission may sell land no longer needed for toll bridge purposes to the general public or to political subdivisions of the state. (Dearing-Florida)
W70-05451

CHAPTER XIII: PULP-MILL WASTE-WATER DISCHARGES INTO PUGET SOUND: AN INDUSTRY VIEWPOINT,
Northwest Pulp and Paper Association, Seattle, Wash.
For primary bibliographic entry see Field 05B.
W70-05453

CHAPTER XIV: THE CHANGING ROLE OF THE COURTS IN WATER-QUALITY MANAGEMENT,
Washington Univ., Seattle. School of Law.
Ralph W. Johnson.
In: Water Resources Management and Public Policy, ed. Thomas H. Campbell and Robert O. Sylvester, University of Washington Press, 1968, p 196-203, 4 ref.

Descriptors: *Civil law, *Water quality control, *Administrative agencies, *Administrative decisions, *Riparian rights, Decision making, Appropriation system, Reasonable use, Water zoning, Long-term planning.
Identifiers: *Statutory administrative law, *Model Water Use Act, Rational approach, Efficient approach, Pollution Control Commission, Court-centered system, Natural flow, Nuisance.

The increasing need for water-quality management and the stepped-up growth of law regarding it has brought about new legal developments in the past 25 years. Common-law control of water quality including the 'riparian rights' system and the appropriation system are summarized. The nature of each and their historical evolvements are traced with regard to change from a court-centered system to an administrative law system, and from 'natural flow' theory to 'reasonable use' theory. However, a number of limitations seriously impairing the usefulness of these legal remedies have brought about their gradual decline and replacement by administrative control. The element of uncertainty for industries under the riparian system led to the Model Water Use Act with a licensing program, but further problems are posed. Public interest tends to go unprotected; statutes of limitations and 'laches' may bar use of riparian rights; consistent policies tend not to evolve; enforcement is hit-or-miss; and expenses are simply too high. Limitations of the court system in handling continuing problems and the lack of necessary draining in legal judges recommend administrative agencies as a more rational and efficient approach. Nevertheless, courts still do play a significant part in the process through review of legislation and administrative action. (See W70-03995). (Preckwinkle-Chicago)
W70-05454

NAVIGABLE WATERWAYS (NAVIGABLE WATER CROSSINGS).

Ark Stat Ann secs 73-2201 thru 73-2216 (Supp 1967).

Descriptors: *Arkansas, *Navigable waters, *Pipelines, Electric cables, Administrative agencies, Safety, Ownership of beds, Streambeds, Public rights, Public utilities, Construction, Repairing, Operation and maintenance, Judicial decisions, Water rights, Cost allocation, Damages, Legal aspects, Legislation, Administration, Navigable rivers, Land tenure, Relative rights, Permits.
Identifiers: *Water crossings.

The Public Service Commission shall have the power to regulate, in the interest of public safety and public use of waterways, the construction, operation and replacement of all navigable water crossings. The Commission may grant title to state-owned waterway beds to private interests for the construction and maintenance of electric power lines and pipelines. Petitions from such river-crossing proprietors to the Commission must follow the specified form and procedure. Such petition should be granted unless the proposed navigable water crossing would jeoparidize the public safety or interfere with some other paramount public or private use of the waterway or its underlying bed. Once granted, the rights in respect to the crossing shall be perpetual. Decisions of the Commission are reviewable by the Circuit Court of Pulaski County and thereafter by the state supreme court. (Dearing-Florida)
W70-05459

PRIVATE TOLL BRIDGES AND FERRIES.

Ky Rev Stat Ann secs 280.020, 280.130, 280.140, 280.170, 280.210, 280.220, 280.300, 280.310 (1963).

Descriptors: *Kentucky, *Bridges, *Boats, Engineering structures, Legislation, Legal aspects, Bridge construction, Civil engineering, Piers, Maintenance, Construction, Highways, Docks, Condemnation, Navigable waters, Streams, Rivers, Banks, Bank protection, Local governments, State governments, Federal government, Operation and maintenance, Interstate.
Identifiers: *Ferries.

A certificate of convenience and necessity obtained from the Department of Highways is required to operate a toll bridge or ferry. Each ferry company must, where it is practicable, maintain a dock at each landing. The construction of docks, aprons, and moorings is regulated. A Kentucky corporation constructing, maintaining and operating a bridge across a Kentucky boundary stream or river may consolidate with a similar corporation of an adjoining state. The consolidated corporation can construct, maintain and operate the bridge and condemn the necessary land. The county courts have jurisdiction to establish ferries and grant ferry privileges upon any navigable water in or adjoining the county and to regulate, control

and revoke the same. Condemnation of land for ferry purposes is regulated. The ferry owner or lessee of any ferry operated for compensation must grade and pave the banks of the stream where a road or public highway not maintained by the state crosses the stream. Upon the approval of the United States Chief of Engineers and the Secretary of War, any person may build a bridge over navigable Kentucky waters. The powers of corporation operating a bridge in Kentucky include maintenance and operation of the bridge and collection of reasonable tolls for the use of such bridge. (Powell-Florida)
W70-05460

OBSTRUCTION OF WATERCOURSES; DESTRUCTION OF BRIDGES, MILLDAMS, LEVEES, AND DITCHES; TAKING FISH FROM PRIVATE POND.

Mo Ann Stat secs 560.525, 560.540, 560.545, 560.560, 560.565 (1953).

Descriptors: *Missouri, *Structures, *Obstruction to flow, *Fishing, Legislation, Bridges, Mill dams, Dikes, Levees, Water utilization, Riprap, Ponds, Fish conservation, River regulation, Ditches, Legal aspects, Channel improvement.
Identifiers: Penalties (Criminal).

The willful and malicious damage to or destruction of any bridge, milldam, hydraulic power or reservoir dam, levee, or any supporting structure is prohibited. The willful and malicious injury, destruction, or obstruction of any ditch or levee constructed pursuant to state law is a misdemeanor. It is misdemeanor to obstruct any watercourse by blocking it with brush, logs, or trees. Good-faith riprapping of stream banks, lawful straightening of watercourses, and rafting or logging operations are expected. Anyone entering lands for the purpose of taking fish from any private pond without the consent of the owner commits a misdemeanor. (Caldwell-Florida)
W70-05463

ST LAWRENCE SHORES, INC V STATE (CONDEMNATION OF CREEK OWNED BY PLAINTIFF).

302 NYS2d 606-615 (Ct Cl 1969).

Descriptors: *New York, *Eminent domain, *Ownership of beds, *Navigable rivers, Riparian rights, Navigable waters, Streambeds, Right-of-way, Reasonable use, Damages, Easements, Access routes, Rivers, Riparian land, Severance, Public rights, Banks, Judicial decisions, Land tenure, Water rights, Non-consumptive use, State governments.

The state condemned all of that portion of a creek owned by plaintiff landowner to build a bridge. Plaintiff claimed, among his items of damage, that the phrase 'fee without access' used in describing the state's title to the land in question deprived him of the right of access between his upstream lands and the river into which the creek flowed. The court held that as the state may, like any other landowner, own the streambed, it does not own the water which courses through the stream and has no right to deprive the public of the right to use the navigable creek. 'Fee without access' referred only to the space which the bridge itself occupied and did not deny plaintiff the use of the creek. Therefore, since the plaintiff was not denied access to his upstream property via the creek, he was not entitled to an award for damages. (Caldwell-Florida)
W70-05516

6F. Nonstructural Alternatives

FLOOD WARNING AND COMMUNITY ACTION.
Nebraska Soil and Water Conservation Commission, Lincoln.

Nebraska State Water Plan Publication No 403, August 1969. 15 p, 3 fig, 18 photo.

Descriptors: *Floods, *Nebraska, *Non-structural alternatives, Planning, Flood forecasting, Water management (Applied), Zoning, Flood damage, Legislation.
Identifiers: *Flood warning.

Floods in Nebraska cause an average accountable loss to the economy of over $20,000,000 each year. It is estimated that the total loss due to floods in Nebraska is nearly $40,000,000 per year. The cost of many steps toward reduction of flood damages is insignificant compared to the damage caused by even minor floods. Specific actions are suggested which would help achieve a reduction of flood losses. This Recommendation, a part of the State Water Plan requested by Legislative Resolution No. 5 of the regular 1967 Session, deals with the opportunity to reduce flood losses by advance planning for prompt, effective flood warnings and responsive community action. The present organization for emergency action is evaluated and improvements are proposed. (Knapp-USGS)
W70-05175

WISE USE OF FLOOD PLAINS.
New England River Basins Commission, Boston, Mass.

New England River Basins Commission Interim Report, July 1969. 35 p, 4 fig, append.

Descriptors: *Non-structural alternatives, *Flood plain zoning, *Water management (Applied), *New England, Land use, Planning, Water policy, Water resources development, Recreation, Scenery, Zoning.
Identifiers: Flood plain management.

Flood plain development and the use of non-structural alternatives in New England are reviewed. In many cases, structural measures are not feasible, economically justified, or politically acceptable. The alternative is non-structural measures or Flood Plain Management. Flood plains often have high-value uses other than commercial, residential, industrial or public development, all of which are subject to flood damage. Valley storage acts as a natural reservoir, reducing downstream flood damage. Flood plains are of value for a variety of outdoor recreation activities, are highly scenic, and provide ribbons of green and open space in both rural and urban areas. Wetlands constitute critical fish and wildlife habitat, often to the degree that their preservation is fully justified for these purposes quite apart from flood damages. An inventory was made of existing programs and policies at all levels of government as related to flood plains, wetlands and open spaces. (Knapp-USGS)
W70-05177

FLOOD PREVENTION AND DAMAGE REDUCTION.
Nebraska Soil and Water Conservation Commission, Lincoln.

Nebraska State Water Plan Publication No 401, July 1968 (revised). 19 p, 1 fig, 26 photo.

Descriptors: *Flood protection, *Nebraska, *Non-structural alternatives, Flood plain zoning, Regulation, Building codes, Planning, Legislation, Economics, Flood damage, Flood forecasting.
Identifiers: Flood prevention.

Recommendations for flood control and damage reduction for inclusion in Nebraska's State Water Plan are presented. Techniques recommended include land regulation, zoning, floodways, and various structures. The main emphasis is on regulation of land use and other non-structural alternatives. The economics and social aspects of the various methods are briefly discussed. A list of recommendations for action is presented for consideration by the Governor and the Legislature. (Knapp-USGS)
W70-05187

THE QUALITY OF THE ENVIRONMENT: A REVIEW,
Toronto Univ. (Ontario). Dept of Geography.
Ian Burton.
The Geographical Review, Vol 58, No 3, p 472-481, 1968. 39 ref.

Descriptors: *Environmental sanitation, Ecosystems, Cost-benefit analysis, Pollution abatement, Legislation, Social aspects, Political aspects, Economic feasibility, Reviews.
Identifiers: Quality of living, Individual rights, Fundamental issues.

The Environmental Pollution Panel of the President's Science Advisory Committee says the public should recognize the right of the individual to the absence of environmental pollution but fails to suggest solutions for securing such rights. Political and legislative action has been ahead of knowledge and understanding, although behind public opinion, which continues to be stimulated by forebodings and conservationists' cries. Morally and ideologically neutral research is the basis for good politics. Herfindahl and Kneese (See W69-07180) state that desires must be balanced against costs and assume that the economic evaluation would be the road to progress. Turvey rejects technical economic calculation for legal and institutional means: regulating or taxing where externalities exist (a smoky factory) or internalizing side effects (merge upstream sanitary authority with downstream water-supply authority). Legal solutions are costly and time consuming, thus technical solutions are sought, which may create greater problems in the future. Homo sapiens (particularly the native of an environment) is adaptive to the point of accepting the worst of environments, says Sonnenfeld. As travel and migration increase the proportion of immigrants' demands for environmental quality rises. (Powers-Wisconsin)
W70-05373

6G. Ecologic Impact of Water Development

WATER, EARTH AND MAN.

Richard J. Chorley, editor. London, Methuen and Co, 1969. 588 p.

Descriptors: *Water resources, *Hydrology, *Hydrogeology, *Social aspects, *Economics, Water resources development, Geomorphology, Surveys, Reviews, Ecology, Environment, Urbanization, Human resources, Natural resources.
Identifiers: Economic geography, Georgraphy, Social geography.

The theme of this book is that the study of water provides a logical link between an understanding of physical and social environments. Each chapter develops this theme by proceeding from the many aspects of water occurrence to a deeper understanding of natural environments and their fusion with the activities of man in society. In this way water is viewed as a highly variable and mobile resource in the widest sense. Not only is it a commodity which is directly used by man but it is often the mainspring for extensive economic development, commonly an essential element in man's aesthetic experience, and always a major formative factor of the physical and biological environment which provides the stage for his activities. (Knapp-USGS)
W70-05173

THE STRATEGY OF ECOSYSTEM DEVELOPMENT,
Georgia Univ., Athens.
Eugene P. Odum.
Science, Vol. 164, 18 April 1969, p. 262-270, 2 fig, 2 tab, 38 ref.

Descriptors: *Ecosystems, Ecology, Succession.
Identifiers: *Metropolitan water resources management, *Ecosystem development, Ecological succession, Homeostasis.

The principles of ecological succession bears importantly on the relationships between man and nature. The framework of successional theory needs to be examined as a basis for resolving man's present environmental crisis, including metropolitan water resource management. A tabular model of ecological succession is presented indicating the trend to be expected in the development of ecosystems. The change in ecosystem attributes from developmental stages to mature stages is outlined. Among the groups of ecosystem attributes considered are community energetics, community structure, life history, nutrient cycling, selection pressure, and overall homeostasis. Contrasting characteristics of young and mature type ecosystems are discussed; young ecosystems are characterized by production, growth, and quantity; mature ecosystems by protection, stability. More emphasis needs to be placed on compartmentalization, so that growth-type, steady-state, and intermediate-type ecosystems can be linked with urban and industrial areas for mutual benefit. A compartment model of the basic kinds of environment required by man, partitioned according to ecosystem development and life-cycle resource criteria is described. Four main components are described: the protective environment (mature systems), the productive environment (growth systems), the compromise environment (multiple-use systems), and the urban-industrial environment (non-vital systems). (Davis-Chicago)
W70-05442

THE ROLE OF MAN IN ESTUARINE PROCESSES,
Maryland Univ., Solomons. Natural Resources Inst.
For primary bibliographic entry see Field 05B.
W70-05539

07. RESOURCES DATA

7A. Network Design

CONCEPTS FOR THE DESIGN OF STREAMFLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
R. W. Carter, and M. A. Benson.
Geological Survey Open-file report, November 25, 1969. 33 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Data collections, *Streamflow, *Hydrologic data, *Network design, *Systems analysis, Planning, Statistical methods, Statistics, Model studies, Surface waters.
Identifiers: Data requirements.

The principal elements in surface water data program planning are (1) establishing the objective and goals of the program, (2) examining and analyzing all available data to determine which of the goals have already been met, (3) considering alternate means of meeting the remaining goals, and (4) identifying elements that should be included in the future program. The framework for program design is related to four classifications of data which are: data for current use, data for planning and design, data for definition of long-term trends, and data on stream environment. Accuracy equivalent to 25 years of record is specified for principal streams (over 500 square miles), and an accuracy equivalent to 10 years of record is specified for minor streams. A systems approach to definition of flow characteristics is required for regulated streams. An analysis of all available data helps provide the basis for design of the streamflow data program. (Knapp-USGS)
W70-05073

EVALUATION OF WATER-QUALITY MONITORING IN THE ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
Joe A. Moreland, and John A. Singer.
Geological Survey Open-file report, 1969. 27 p, 5 fig, 3 tab, 12 ref.

Descriptors: *Water quality, *Monitoring, *Groundwater, *California, *Observation wells, Networks, Data collections, Water analysis, Saline water intrusion, Water pollution sources, Path of pollutants, Irrigation water, Municipal water.
Identifiers: Orange County (Calif).

Water samples for chemical analysis are collected periodically from 272 wells in the Orange County, California Water District by 16 agencies. Many other wells are sampled at infrequent intervals by these and other agencies. The efficiency and completeness of the entire network are evaluated, and changes in standards for the network are suggested. Complete chemical analysis of a water sample is not always necessary. Selective analyses suggested for obtaining specific types of data include: (1) Chloride determination and electrical conductivity measurements on samples from aquifers susceptible to intrusion of sea water; (2) sulfate, bicarbonate, and nitrate determinations on samples from aquifers underlying the forebay area; and (3) sodium, sulfate, chloride, and boron determinations and electrical conductivity measurements on samples from aquifers used as a source of irrigation water. (Knapp-USGS)
W70-05170

7B. Data Acquisition

STRATIFIED RESERVOIR CURRENTS: PART II, THE NUMAC METHOD FOR NON-HOMOGENEOUS UNCONFINED MARKER-AND-CELL CALCULATIONS,
Oregon State Univ., Corvallis. Engineering Experiment Station.
For primary bibliographic entry see Field 02E.
W70-05049

INTEGRATING-FLOAT MEASUREMENTS AT LOW VELOCITIES,
Missouri Univ., Columbia. Dept. of Civil Engineering; and Tennessee Valley Authority, Norris. Hydrology Lab.
Henry Liu, and Larry D. Martin.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7027, p 143-151, January 1970. 9 p, 1 fig, 1 tab, 7 ref, append. OWRR Project A-006-MO.

Descriptors: *Current meters, *Stream gages, *Flow measurement, Instrumentation, Open channel flow, Discharge (Water), Velocity, Floats.
Identifiers: Float gages.

Flow measurement by the integrating-float method was tested in a rectangular flume 1 ft wide and 2 ft deep. Stainless steel hollow spheres, 5/8-in. diam, were used as floats. Accuracy of the technique was evaluated by comparing discharges measured with floats to those measured with standard weirs. For flows in the velocity range tested (between 0.02 and 0.3 fps), the average error for 40 runs was less than 2.5%, and there was no tendency for increase in error as velocity decreased. (Knapp-USGS)
W70-05066

CONCEPTS FOR THE DESIGN OF STREAMFLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-05073

A VOLUMETRIC RESPIROMETER FOR STUDIES OF AERIAL AND AQUATIC OXYGEN CONSUMPTION,
Royal Univ. of Malta, Valletta. Marine Biology Research Group.
J. V. Bannister, W. H. Bannister, and H. Micallef.
Oikos, Vol 20, No 2, p 534-536, 1969. 3 fig, 4 ref.

Descriptors: *Instrumentation, Oxygen, Respiration.
Identifiers: Micro-dosimeter, Respirometer, Fluid-driven magnetic stirrer, Aquatic oxygen consumption, Aerial oxygen consumption.

The constructional and operational details of a volumetric plastic respirometer are described. The respirometer embodies a submersible fluid-driven magnetic stirrer to equilibrate water with the gas phase when measurements of aquatic respiration are made, and a micro-dosimeter which gives direct readings of oxygen consumption which may be reset to the zero mark after each reading. (Haskins-Wisconsin)
W70-05089

SIMPLE STREAM TANK SIMULATING A RAPIDS ENVIRONMENT,
Manitoba Univ., Winnipeg. Dept. of Zoology.
J. H. Gee, and V. G. Bartnik.
Journal Fisheries Research Board of Canada, Vol 26, No 8, p 2227-2230, 1969. 1 fig, 7 ref.

Descriptors: *Simulation analysis, *Model studies, *Fish, Streamflow, Hydraulic models, Measurement, Spawning.
Identifiers: Cyprinidae, Rhinichthys, Aquarium, Prespawning, Stream tank, Rapids environment.

The construction of a simple and inexpensive stream tank is described. A false bottom, capable of supporting gravel to a depth of 10 centimeters, is suspended across the width of the aquarium, providing a rapids environment of 0.6 square meters with a slope of 1 centimeter rise per 12 centimeter length. Circulation on a vertical plane is provided by compressed air (12-15 psi) available at four outlets at one end of the aquarium. Water lifted by the compressed air is deflected off a glass plate and passed over and along the false bottom. Flow over the plate can be varied between 0.014 and 0.50 meters/second depending on the number of outlets open. Stainless steel screens running across the width of the aquarium at either end of the false bottom retain the fish and enable food items to be recirculated over the bottom and constantly available to the fish. Two of these stream tanks were used to investigate and compare the prespawning and spawning behavior of two species of dace (Cyprinidae: Rhinichthys). (Haskins-Wisconsin)
W70-05096

HOT-FILM TURBULENCE MEASUREMENTS IN WATER FLOW,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
Francois J. Resch.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7177, p 787-800, March 1970. 14 p, 14 fig, 16 ref, append.

Descriptors: *Turbulence, *Turbulent flow, *Current meters, Instrumentation, Water measurement, Velocity, Vortices.
Identifiers: Hot-film anemometers, Turbulence meters.

Turbulence measurements in water may be made using hot-film anemometers. Two special types of hot-film probes were tried: (1) wedge-shaped probes which must take into account a drift of the characteristics which can be corrected experimentally; and (2) conically shaped probes which do not present the disadvantage of drift. A study of the heat transfer between probe and water led to the establishment of a non-dimensional relationship. Measurements of relative intensities and energy spectra were carried out and compared with those

of previous authors in air and for dynamically similar flows. Hot-film anemometry methods can be used, under controlled conditions, for turbulence measurements in water with the same degree of accuracy as found for measurements in air. (K-napp-USGS)
W70-05128

INTEGRATING-FLOAT MEASUREMENTS IN TURBULENT FLOWS,
Missouri Univ., Columbia. Dept. of Civil Engineering, and Public Health Service, Columbia, Mo.
Henry Liu, and Charles D. Morris.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7101, p 565-572, February 1970. 8 p, 1 fig, 1 tab, 5 ref, append.

Descriptors: *Flow measurement, *Floats, *Turbulent flow, *Hydraulic models, *Stream gages, Dispersion, Hydrology, Open channel flow, Turbulence, Current meters.
Identifiers: Integrating-float current meters.

The effect of turbulence on discharges measured by the integrating-float method is studied. Based on Taylor's classical theory on diffusion of fluid particles by continuous movements, an equation is derived giving the dispersion of floats in a homogeneous turbulence field. It shows that larger errors are expected in using the float technique when the relative intensity and scale of turbulence are large, and when the float used rises rapidly. In the experimental part of the study, the integrating-float technique was used to measure discharges in a laboratory flume. A grid was sometimes placed in the flume to decrease turbulence scale and intensity. Results obtained are weir. For a total of 16 runs taken in flows with turbulence of various intensities and scales, the average errors based on 18 releases are 1% for cases with grid and 3% for cases without grid. (Knapp-USGS)
W70-05140

LINEAR PROPORTIONAL WEIRS,
Regional Engineering Coll., Rourkela (India). Dept. of Civil Engineering.
P. Sreenivasulu, and R. Raghavendran.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7062, p 379-389, February 1970. 11 p, 8 fig, 2 tab, 9 ref, append.

Descriptors: *Stage-discharge relations, *Weirs, *Flow measurement, Instrumentation, Model studies, Hydraulic models, Stream gages.
Identifiers: Parabolic weirs.

The profile equation of weirs with parabolic bottoms is analytically obtained for the condition of discharge varying linearly with head. The result has the form of an integral equation of the Abel type. The solution is obtained in a simple form. Experiments were conducted on a weir plate at the end of a rectangular channel 5.2 m long, 40 cm wide, and 62 cm deep. The experimantal results confirm the linearity existing between the discharge and the head, which is measured above an analytically fixed datum line. A table shows coordinates of the profile in a convenient nondimensional form. The variation of the coefficient of discharge and its recommended value are described. (Knapp-USGS)
W70-05146

DEPTH-INTEGRATING AND DIP SAMPLERS,
Agricultural Research Service, Riesel, Tex. Southern Plains Branch.
Walter G. Knisel, Jr., and Ralph W. Baird.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7084, p 497-507, February 1970. 11 p, 9 fig, 1 tab, 13 ref, append.

Descriptors: *Suspended load, *Sampling, *Measurement, Instrumentation, Reliability, Statistical methods, Hydraulics, Sedimentation, Sedimentology.
Identifiers: Suspended load samplers.

Comparative tests of depth-integrating and dip samplers were made for fine-grained suspended sediment. Approximately 60% of the suspended load was 2 microns and smaller in size. Differences between suspended-sediment concentrations obtained with dip samplers and depth-integrated samplers were statistically significant. Concentrations of depth-integrated samples averaged 1.02% greater than concentrations of dip samples. (K-napp-USGS)
W70-05149

TECHNIQUES FOR THE TRACING OF SUBTERRANEAN DRAINAGE,
For primary bibliographic entry see Field 02F.
W70-05166

AN EVALUATION OF RADAR IMAGERY AS A TOOL FOR DRAINAGE BASIN ANALYSIS,
Kansas Univ., Lawrence. Dept. of Geography.
Roger M. McCoy.
PhD Thesis, Kansas University, 1967. Reproduced by University Microfilms, Ann Arbor, Mich, 1968. 102 p, 37 fig, 12 tab, 57 ref. NASA Contract 17-004-003, NASA Grant NsG-298.

Descriptors: *Remote sensing, *Terrain analysis, *Radar, *Drainage patterns (Geologic), Topography, Geomorphology, Drainage density, Tributaries, Surveys, Mapping, Instrumentation.
Identifiers: Drainage basin analysis, Stream length, Stream order, Bifurcation ratio.

Radar images offer an untested, but highly promising, tool for drainage basin analysis. The large coverage and the abundance of landform detail make radar especially suited for areal reconnaissance studies. An analysis was made of drainage basins on a K-band radar imaging system, and two other radar systems were used for comparison. Each of the basins selected on radar imagery was also examined on USGS 7-1/2 minute topographic quadrangles. The same methods of stream ordering, counting, measuring, and data handling were applied to map and radar drainage displays. Preliminary analysis of drainage basins on AN/APQ-69 and a synthetic aperture radar shows that first and second-order streams may be missing entirely on those systems. The K-band radar imagery, however, shows a substantial number of first-order streams, and a correlation and regression analysis was used to determine the actual relationship between radar data and topographic map data. Drainage area, basin perimeter, bifurcation ratio, average length ratio and circularity ratio can be measured from the imagery with little difference from the map derived values. Terrain slope can be derived from measurements of slope lengths and depression angles using two different radar views of the same slope. (Knapp-USGS)
W70-05180

FIELD METHODS OF WATER HARDNESS DETERMINATION,
Ian Douglas.
British Geomorphological Research Group Technical Bulletin No 1, 1968. 35 p, 2 fig, 6 tab, 83 ref.

Descriptors: *Water chemistry, *Hardness (Water), *Water analysis, Analytical techniques, On-site tests, On-site investigations, Karst, Limestones, On-site laboratories, Sampling.
Identifiers: Karst hydrology.

Tablet methods can give resonably accurate determinations of water hardness. Their simplicity, compactness and cheapness makes them particularly suitable for reconnaissance field investigations, and for use by cave exploration parties who make available so much of the basic data which is used by karst morphologists. These tablet methods should be regarded not as a replacement for laboratory determinations, but as a means of extending the amount of data available on karst water quality. The possibility of field measurements of pH, temperature, spring or river discharge and hardness makes reconnaissance observations of karst processes feasible, and should increase the scientific value of many expeditions to remote areas. An annotated bibliography of field testing procedures, laboratory analytical methods, and karst hydrogeochemistry is included. (Knapp-USGS)
W70-05183

EARTHQUAKE PREDICTION AND CONTROL,
Geological Survey, Menlo Park, Calif.
L. C. Pakiser, J. P. Eaton, and J. H. Healy.
Science, Vol 166, No 3912, p 1467-1474, Dec, 1969. 8 p, 11 fig, 31 ref.

Descriptors: *Earthquakes, Faults (Geology), Geologic investigations, Geology, Geophysics, Underground explosions, Reservoirs, California, Nuclear explosions, Injection wells, Impounded waters, Seismic investigations, Hazards, Safety, Seismology, Seismic studies, Disasters, Bibliographies.
Identifiers: Earthquake theory, Earthquake zones, *Earthquake forecasting, *Earthquake control, Earthquake warning systems.

Studies of natural and man-made earthquakes are providing knowledge on earthquake characteristics and are offering some prospects for successful prediction and perhaps eventual control. Earthquake activity is discussed, particularly investigations of the San Andreas fault zone in California and observations of seismic activity associated with filling reservoirs, subsurface fluid injection, and underground nuclear explosions. Combined leveling and geodimeter surveying accompanied by continuous monitoring of seismic activity offers a basis for a long-range earthquake-warning system. Short-range prediction of earthquakes may be achieved by continuous monitoring of ground tilt, strain, seismic activity, and possibly fluctuations in the earth's magnetic field. Studies of man-made earthquakes indicate the possibility of developing a practical method of dislodging locked sections of a major fault, thereby releasing the accumulated strain energy and inhibiting the development of a disastrous earthquake. (USBR)
W70-05218

SEISMIC WAVE VELOCITY AS A MEANS OF IN-PLACE DENSITY MEASUREMENT, FINAL REPORT - PART 1 OF 2,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 08D.
W70-0˜247

GRANULOMETER--A SEDIMENT ANALYZER DIRECTLY WRITING GRAIN SIZE DISTRIBUTION CURVES,
Central Geological Inst., Prague (Czechoslovakia).
Jiri Brezina.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1627-1631, 1969. 2 fig, 12 ref.

Descriptors: *Sediments, *Statistical methods, Analytical techniques, Suspension, Electronic equipment, Distribution (Curves).
Identifiers: *Sediment analysis, *Granulometer, Settling particles, Corey's shape, Grain size, Modified settling tubes, Thermo-variomatic control, Transducer.

The name 'granulometer' was applied to a modification of the Woods Hole Rapid Sediment Analyzer. The modification eliminates the need for temperature stabilization and can plot grain size distribution curves up to 250 samples per day. Results are well adapted for statistical analyses by computer. (Wilde-Wisconsin)
W70-05268

DESIGN FEATURES OF INTACT LEAF THERMOCOUPLE PSYCHROMETERS FOR MEASURING WATER POTENTIAL,
Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.;

Agricultural Research Service, Riverside, Calif. Salinity Lab.; and Army Electronics Command, Fort Huachuca, Ariz. Research Div.
For primary bibliographic entry see Field 02I.
W70-05294

UNDERWATER LASER SURVEYING SYSTEM,
TRW Systems Group, Redondo Beach, Calif.
Donald R. Borchardt.
Available from the Clearinghouse as AD-859 968, $3.00 in paper copy, $0.65 in microfiche. Final Report 21, NCEL-CR-69.028, 12 Mar 69, 131 p. Contract N62399-69-C-0010 for the Naval Facilities Engineering Command.

Descriptors: *Surveying instruments, Mapping, Hydrography, *Oceanography.
Identifiers: Tekite project, Underwater laser surveying, Gas lasers, Ocean bottom topography.

The report describes the development of an Underwater Laser Surveying System usable by two divers for plot layout, bottom contour mapping and other underwater surveying missions. The portable cold-cathode argon laser is the central element to the system. The supporting test program demonstrated the feasibility of the system for plot layouts to 6 inch accuracy and contour elevation to 1.2 inch accuracy oer ranges of up to 100 feet. Operating procedures and maintenance instructions for the system are also included.
W70-05318

THE RELATIONSHIP OF FRESH-WATER PROTOZOAN COMMUNITIES TO THE MACARTHUR-WILSON EQUILIBRIUM MODEL,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology; Virginia Polytechnic Inst., Blacksburg. Dept of Forestry and Wildlife; and Michigan Univ., Ann Arbor. Dept. of Botany.
John Cairns, Jr., M. L. Dahlberg, Kenneth L. Dickson, Nancy Smith, and William T. Waller.
The American Naturalist, Vol 103, No 933, p 439-454, 1969. 5 fig, 3 tab, 28 ref.

Descriptors: *Model studies, *Protozoa, *Methodology, Invasion, Population, Environmental effects, Succession, Dominant organisms, Biological communities, Equilibrium.
Identifiers: *MacArthur-Wilson model, *Colonization rates, Extinction rates, Douglas Lake (Mich).

The colonization rate of protozoa on artificial substrates fits a simple exponential curve. In early stages of invasion, colonization rate greatly exceeded extinction rate; colonization and extinction rates approached but did not reach equilibrium as the number of species increased. The extinction rate of protozoa species did not follow the simple exponential curve as suggested by the MacArthur-Wilson equilibrium model. Results suggest occurrence of favorable interactions between protozoan species. Numbers of individuals per species increased following initial colonization period; this was followed by a secondary increase in specie numbers. It is suggested that secondary increase in number of species was due to microenvironmental changes induced by already-established protozoa. Results indicate that formation and composition of protozoan communities on artificial substrates are the result of interactions comparable to those proposed in the MacArthur-Wilson model. (Voightlander-Wisconsin)
W70-05374

A NEW MIDWATER TRAWL FOR SAMPLING DISCRETE DEPTH HORIZONS,
National Inst. of Oceanography, Wormley (England).
Malcolm R. Clarke.
Journal of the Marine Biological Association of the United Kingdon, Vol 49, No 4, p 945-960, 1969. 8 fig, 16 ref, 2 plates, append.

Descriptors: *Instrumentation, *Sampling, Measurement, Depth, Vertical migration, Fish, Crustaceans, Mollusks, Aquatic animals.
Identifiers: *Vertical distribution, Midwater trawl, Micronekton, Acoustic release gear, Depth telemetering pinger.

To facilitate studies of vertical distribution of water-inhabiting animals, a modification of the Tucker's trawl was designed. To regulate the sampling of micronekton, including fish, decapodes, and cephalopods, the trawl is provided with opening and closing device, acoustic release gear, and depth telemetering pinger. The net and release gear were developed for use from RRS Discovery for recording vertical migration of particular size animals. However, modifications of the basic design for use on other ships do not present difficulties. (Wilde-Wisconsin)
W70-05376

AIRBORNE FLUOROMETER APPLICABLE TO MARINE AND ESTUARINE STUDIES,
Geological Survey, Washington, D.C.; and Perkin-Elmer Corp., Norwalk, Conn.
George E. Stoertz, William R. Hemphill, and David A. Markle.
Marine Technology Society Journal, Vol 3, No 6, p 11-26, 1969. 24 fig, 16 ref.

Descriptors: *Instrumentation, *Sampling, *Measurement, *Fluorometry, Dye releases, Currents (Water), Remote sensing, Sea water, Chlorophyll, Oil, Algae, Pacific Ocean.
Identifiers: *Fraunhofer line discriminator, Rhodamine WT dye, Airborne tests, Oil spills, Geological SS Polaris, Chlorophyll fluorescence, Fabry-Perot filters, Solar Fraunhofer lines, Attenuation measurement apparatus, Hydrogen F line.

This study was concerned with performance and possible improvements of the Fraunhofer line discriminator (FLD). This fluorometer is the first to provide direct measurements of fluorescence in broad daylight and from a remote platform, thus greatly facilitating studies of current flow and rate of dispersion of rhodamine and other tagging dyes. The smallest detectable increment of rhodamine wt in 0.5 meter depth was 1 ppb. Temperature significantly influenced the FLD results. Shipboard and helicopter tests of the FLD and plotting of flight paths by tracking radar were successful. The dye was detectable in airborne tests at altitudes exceeding 5000 feet. A new design having only one photomultiplier should eliminate the need for monitoring standard targets. Additional improvements may enable detection of chlorophyll fluorescence, oil spills or leakages, algal blooms and indication of pollution, and facilitate dispersion studies. (Wilde-Wisconsin)
W70-05377

AN ANALYSIS OF MARINE CORER DYNAMICS,
Navy Underwater Sound Lab., New London, Conn.
Kirk T. Patton, and Gary T. Griffin.
Marine Technology Society Journal, Vol 3, p 27-40, 1969. 11 fig, 1 tab, 7 ref, appendix.

Descriptors: *Cores, *Mathematical models, *Computer programs, Sediments, Sedimentary structures, Kinetics.
Identifiers: Marine cores, Core distortion, Corer dynamics, Navy Underwater Sound Laboratory.

A mathematical model and computing program were developed to resolve questions pertinent to the maximum penetration of corers, pipe buckling, and distortion of the core sample. The model is used to compute the kinetic energy of the corer just prior to its impact into the sediment. The program is terminated when kinetic and potential energy have been dissipated by friction forces. The program is applicable to all types of designs except piston corers. Investigations of the influence of corers' size, cutter angle, cutter size, and other parameters illustrate the versalitity of this program. (Wilde-Wisconsin)
W70-05378

SAMPLING RESERVOIR FISH POPULATIONS USING MIDWATER TRAWLS,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark. South Central Reservoir Investigations.
For primary bibliographic entry see Field 02H.
W70-05382

ENUMERATION OF FRESHWATER PHYTOPLANKTON CONCENTRATED ON THE MEMBRANE FILTER,
Wisconsin Univ., Madison. Dept. of Botany.
Clarence D. McNabb.
Limnology and Oceanography, Vol 5, No 1, p 57-61, 1960. 4 tab, 16 ref.

Descriptors: *Analytical techniques, *Microscopy, *Phytoplankton, Estimating, Distribution, Evaluation.
Identifiers: *Membrane filters, *Plankton counts, Quadrat scoring, Random distribution count.

Both haemacytometer and Sedgewick-Rafter counting chambers are of such thickness that nannoplankton, observed best under higher magnification, may be underestimated. A membrane filter technique is described which offers complete plankton counts at any magnification desired. Other advantages over conventional methods are described. The sample is 'fixed' (4% of a 40% formaldehyde solution) and passed through an HA Millipore filter which is then placed on a glass slide and 'cleared' with immersion oil for 24 hours. A coverslip may be placed in the cleared slide before microscopic observation. The percentage of fields in which a species occurs is validly converted to a theoretical average number of individuals per field. The theoretical density obtained and the actual density determined by time-consuming counting are nearly similar values when 25 or more fields are scored. (Gerhold-Wisconsin)
W70-05388

CHEMILUMINESCENT METHOD FOR DETECTING MICROORGANISMS IN WATER,
St. John's Univ., Jamaica, N.Y. Dept. of Biology.
For primary bibliographic entry see Field 05A.
W70-05391

THE TURNOVER RATIO IN PRODUCTION ECOLOGY OF FRESHWATER INVERTEBRATES,
Minnesota Univ., St Paul. Dept. of Entomology, Fisheries, and Wildlife.
Thomas F. Waters.
The American Naturalist, Vol 103, No 930, 1969. 6 fig, 5 tab, 18 ref.

Descriptors: *Invertebrates, *Methodology, *Productivity, *Secondary productivity, *Measurement, Data collections, Evaluation, Growth stages, Benthic fauna, Aquatic insects, Crustaceans.
Identifiers: *Turnover ratio, Allen curves.

Turnover ratios, defined as the ratio of a cohort's production to the mean standing crop determined during the life of that cohort, are examined for their possible utility in estimating rates of production. Most turnover ratios for benthic invertebrates vary from 2.5 to 5, having a mode of about 3.5. Turnover ratios computed from families of growth-survivorship curves (Allen curves), assuming most probable conditions, varied from three to four for aquatic insects and somewhat higher for crustaceans. Relative size of final population appears to have greatest effect on shape of Allen curve and hence could affect estimate of turnover ratio. Production estimates based on a turnover ratio assumed from Allen curves would be limited to discrete cohorts. Use of annual turnover ratios

for entire benthic fauna is suggested; this method must await additional empirical information on life cycles of benthic forms. Turnover ratios obtained as equal to life-cycle instantaneous growth rates were similar to those obtained from Allen curves, but averaged about one unit larger. Graphical and tabular data include types of curves considered and calculated turnover ratios. (Voigtlander-Wisconsin)
W70-05396

A HYDRAULIC CORER FOR USE IN WATER SATURATED SEDIMENT,
Massachusetts Univ., Amherst.
John A. Gifford.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1619-1621, 1969. 3 fig, 7 ref.

Descriptors: *Saturated soils, *Sampling, *Cores, Instrumentation, Measurement, Soil density probes.
Identifiers: Hydraulic core sampler.

A simple lightweight suction corer, utilizing expandable plastic core liner, delivers continuous core samples up to 10 feet in length without a loss of sediment's interstitial water. (Wilde-Wisconsin)
W70-05398

A SMALL LABORATORY APPARATUS FOR MEASURING ACCELERATED LOSS RATES OF PESTICIDE DEPOSITS BY 'RAINWASHING',
Rothamsted Experimental Station, Harpenden (England).
F. T. Phillips.
Chemistry and Industry, p 414-415, March 29, 1969. 1 fig, 1 tab, 1 ref.

Descriptors: *Pesticides, Analytical techniques, Evaluation, Measurement, Rain, Gas chromotography, DDT.
Identifiers: Rainwashing, Liquid chromotography, Residual pesticides, LOVO 192.

The devised laboratory apparatus measures the rates at which pesticides are removed from the dry deposits left on surfaces after spraying. A pesticide-sprayed leaf on a plant is exposed to a jet water washing and the liquid is collected at chosen intervals. The pesticide is extracted with hexane or other solvent, and aliquots of extracts are analysed by gas-liquid chromotography (GLC). Pesticide residue is washed with a solvent from the glass accommodating the leaf, the leaf surface is macerated and extracted with the solvent, and the liquids are subjected to GLC analysis. (Wilde-Wisconsin)
W70-05400

PRELIMINARY EVALUATION OF A CORE SCINTILLATION COUNTER FOR BULK DENSITY MEASUREMENT IN MARINE SEDIMENT CORES,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
Chester Brier, Robert Bennin, and Peter A. Rona.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1509-1519, 1969. 4 fig, 5 tab, 15 ref.

Descriptors: *Sediments, *Soil density probes, Cores, Instrumentation, Rocks, Soils, Radioactivity, Density, Measurement.
Identifiers: *Core scintillation counter, Random radiation, Mass attenuation coefficients, Bulk density measurements, Marine sediments.

The bulk density of a sediment is determined by counting radiation that has passed the core sample. The accuracy of results is influenced by random radiation which must be determined by a statistical analysis. The scintillation counts must be additionally corrected by the Compton coefficient which varies significantly with the nature of sediments and content of water. (Wilde-Wisconsin)
W70-05401

POPULATION MODELS AND TEST POPULATIONS AS RESEARCH TOOLS,
Bureau of Commercial Fisheries, Seattle, Wash. Biological Lab.
Ralph P. Silliman.
BioScience, Vol 19, No 6, p 524-528, 1969. 5 fig, 31 ref.

Descriptors: *Population, *Model studies, *Mathematical models, Dynamics programming, Computer models, Mathematical studies, Exploitation, Predation.
Identifiers: *Population models, *Optimum exploitation rate, Population dynamics, Test populations, Maximum attainable yield.

Use of models in our culture is so widespread as to be taken for granted. Such models serve two purposes: to permit experimentation with objects that are smaller and less costly than the full-scale representations, and to save time. There are two distinct modelling approaches to the study of population dynamics: the use of population models, or the utilization of test populations. A population model is a conceptual structure of mathematical of physical elements, while a test population is a small representative sample of the de facto world. Population models have included mechanical, mathematical, and most recently, computer-generated simulation. Test populations of algae, protozoans, bacteria, insects, and fishes have been employed to study such aspects as predator-prey relations and optimum exploitation rates. Most recently, significant findings relating exploitation rate and yield have been made using test populations and analog computer population models. (Huff-Wisconsin)
W70-05414

MODELS FOR DESCRIBING EXCHANGES WITHIN ECOSYSTEMS,
Wisconsin Univ., Madison. Inst. for Environmental Studies.
For primary bibliographic entry see Field 06A.
W70-05420

NONINSTRUMENTAL FACTORS AFFECTING MEASUREMENT OF STATIC WATER LEVELS IN DEEPLY BURIED AQUIFERS AND AQUITARDS, NEVADA TEST SITE,
Geological Survey, Las Vegas, Nev.
Isaac J. Winograd.
Ground Water, Vol 8, No 2, p 19-28, March-April 1970. 10 p, 6 fig, 13 ref.

Descriptors: *Water levels, *Measurement, *Instrumentation, *Hydrogeology, *Nevada, Water table, Aquifers, Transmissivity, Leakage, Aquicludes.
Identifiers: Nevada Test Site.

Accurate measurement of static water levels in wells tapping deeply buried aquifers and aquitards at the Nevada Test Site requires evaluation of and correction for several factors exclusive of instrumentation. Both the drilling method used and the depth of the hole at the time of measurement significantly affect determination of the static water level for the aquitards, and frequently these factors preclude head determination in an economically justifiable time. Density of fluid in the drill stem and hole deviation affect the determination of accurate static water levels for the aquifers. In the principal aquifers, in which hydraulic gradients are as low as 0.5 foot per mile, direct measurement of depth to water is preferable to pressure-gage measurements at the aquifer face. Case histories and graphs are presented to illustrate the magnitude of errors that can result when these factors are disregarded. (Knapp-USGS)
W70-05479

ELECTRIC WELL LOGGING OF HAWAIIAN BASALTIC AQUIFERS,
Hawaii Univ., Honolulu. Dept. of Geosciences; and Honolulu Board of Water Supply, Hawaii.
Frank L. Peterson, and Chester Lao.
Ground Water, Vol 8, No 2, p 11-18, March-April 1970. 8 p, 5 fig, 10 ref.

Descriptors: *Electrical well logging, *Basalts, *Aquifers, *Hawaii, Electrical studies, Surveys, Resistivity, Water wells, Permeability, Porosity, Water yield, Exploration, Borehole geophysics, Investigations.
Identifiers: Basalt aquifers.

An extensive program of electric well logging has been conducted in Hawaii during the past three years. Electric well logging techniques were found to be useful in Hawaiian basaltic aquifers; however, interpretation of both spontaneous potential logs and resistivity logs varies from the conventional interpretation of electric logs in sediments. The interpretation of fluid conductivity logs in Hawaii follows conventional water well techniques. Spontaneous potentials are thought to result primarily from fluid flow rather than from electrochemical potential. Positive SPs generally indicate zones with flow from the aquifers into the well, and negative SPs generally indicate zones with little flow or flow from the well into the aquifer. Resistivity logs indicate the location, number, individual thickness, and total thickness of permeable and less permeable formations, and are useful as indicators of water-yielding zones. High resistivities generally are indicative of dense impermeable basalts and low resistivities are indicative of porous permeable zones most likely to contribute water to the borehole. Both resistivity and spontaneous potential logs provide a direct measurement of depth to water, depth of casing, and depth of hole. (Knapp-USGS)
W70-05480

METHODS AND DEVICES FOR MEASURING CURRENTS,
Marine Advisers, La Jolla, Calif.
Paul L. Horrer.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 80-89, 1967. 10 p, 3 fig, 1 tab, 7 ref.

Descriptors: *Currents (Water), *Current meters, Instrumentation, Estuaries, Runoff, Tidal waters, Stream gages, Ocean waves, Streamflow, Turbulence.
Identifiers: Price meter, Savonius Roter.

The swiftest currents in estuaries are due to tides and to stream runoff. The current, averaged over a period of tens of minutes to several hours, may be measured by tracing and plotting the trajectory of drogues, patches of contaminants or other tracers. Numerous flow-measuring devices have been developed. The cheapest and simplest of these is the captivity drag, which is usable between the surface and depths of 50 to 100 feet. Current meters with rotating elements are in greater use than all other types. The popular ones include the price meter for stream gaging, the modified Roberts, and the modified Savonius rotor with vane; the last two register speed and compass direction and are used by oceanographers. Rotating element meters are subject to error due to wave action, ship roll, and relatively high frequency turbulence. Solid state flowmeters which are capable of measuring turbulence when rigidly fixed at a point in the flow have been developed, but these are relatively costly and somewhat complicated. (Carstea-USGS)
W70-05543

7C. Evaluation, Processing and Publication

NUMERICAL METHOD OF COMPUTING FLOW PROFILES,
Indiana Dept. of Natural Resources, Indianapolis. Surface Water Section.
For primary bibliographic entry see Field 08B.
W70-05062

NUMERICAL SOLUTION OF SAINT-VENANT EQUATIONS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 08B.
W70-05063

CONCEPTS FOR THE DESIGN OF STREAM-FLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-05073

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER -- PHASE I,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02F.
W70-05116

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER-PHASE II,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02F.
W70-05117

ANALOG COMPUTER SIMULATION OF THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
W70-05118

COMPUTER SIMULATION OF THE HYDROLOGIC SYSTEM OF A MOUNTAIN WATERSHED,
Montana Water Resources Research Center, Bozeman.
Darrel E. Dunn.
Available from the Clearinghouse as PB-190 574, $3.00 in paper copy, $0.65 in microfiche. Completion report, Montana Water Resources Research Center, (1970). 52 p. OWRR Project A-025-MONT.

Descriptors: *Basins, *Computer models, Runoff, *Watershed management, *Surface-groundwater relationships.

A digital computer program has been designed to simulate watershed hydrology. The watershed parameter values which must be supplied to the program are all potentially estimable from short term observations made in the watershed. This is a desirable feature not present in other extant models. Input to the model is weather data, and output includes sequential rates of discharge from the various parts of the system, sequential evapotranspiration data, and sequential storage data. The storage requirements of the program do not exceed the number of registers available in modern computer storage units. The amount of computer run-time required and the large amount of input data required limit the application of the model to small watersheds which merit the expenditure of several thousand dollars. The accuracy of the model has not been definitively tested, but the results of the initial runs combined with field investigation of actual watersheds suggest that the transport equations in the program will have to be modified before an acceptable level of accuracy is obtained.
W70-05125

COMPUTATIONAL PROCEDURES FOR FLOW RESISTANCE LAWS,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
Alan A. Smith.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7142, p 665-679, March 1970. 15 p, 9 fig, 1 tab, 5 ref, append.

Descriptors: *Turbulent flow, *Open channel flow, *Closed conduit flow, *Computer programs, *Flow resistance, Equations, Roughness (Hydraulic), Fluid friction, Hydraulics, Discharge (Water).
Identifiers: Flow equations.

The essentially empirical nature of all fluid resistance laws for turbulent flow is stressed. Normal discharge is the only quantity which is always explicitly calculable in channel flow problems. It is suggested that computer programs should not depend on a specific resistance law but should rather be designed to use any one of a number of normal discharge function subroutines which operate on a standard list of parameters. Other quantities implicitly defined in a flow resistance equation, such as depth, energy gradient or roughness, may then be found by iterating on the explicitly determinable normal discharge. The application of such routines is demonstrated with reference to shape effects and experimentally determined friction laws. Flow diagrams of the basic routines are given. (Knapp-USGS)
W70-05127

SURVEY OF PROGRAMS FOR WATER-SURFACE PROFILES,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Bill S. Eichert.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7098, p 547-563, February 1970. 17 p, 5 fig, 1 tab, 23 ref, append.

Descriptors: *Computer programs, *Profiles, *Stage-discharge relations, *Backwater, *Reviews, Surveys, Computers, Digital computers, Hydraulic models, Subcritical flow, Floods.
Identifiers: Water-surface profiles.

Several highly developed computer programs are available for determining water surface profiles for subcritical flow in rivers and channels. The needs for fast, accurate and inexpensive computation of profiles, and for more sophisticated techniques, can be satisfied by computer programs currently being developed. Current capabilities and limitations of computer programs for determining water surface profiles are reviewed. The need to review detailed output because of the complications of manually selecting and describing representative cross sections is stressed. Several current procedures for determining profiles over and through bridges are presented, and the need for more generalized and more accurate methods is cited. Computer program capabilities of the near future in the area of water surface profiles, as well as some current limitations that probably will be surmounted through the additional capabilities of computers, computer languages and advanced engineering techniques such as aerial photography, are analyzed. (Knapp-USGS)
W70-05147

SEEPAGE STUDY USING ELECTRICAL ANALOG,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering; and Technische Universitaet, Berlin (West Germany). Dept. of Water Structure and Water Economy.
For primary bibliographic entry see Field 02G.
W70-05155

REPORT OF THE COMMITTEE ON TERMS AND EQUIVALENTS,
International Council for the Exploration of the Seas, Charlottenlund (Denmark).

Contributions to Plankton Symposium 1957. Measurements of primary production in the sea. Rapports et Proces-Verbaux des Reunions, Vol 144, p 15-16, 1958.

Descriptors: *Primary productivity, *Sea water, *Measurement, Standing crop, Productivity, Biomass, Carbon, Phytoplankton, Chlorophyll, Organic matter, Nitrogen, Zooplankton, Phosphorus, Proteins, Nannoplankton, Diatoms, Bacteria.
Identifiers: *Terms, *Definitions, *Equivalents, Turnover rate, Gross primary production, Displacement volume, Dry plankton, Dry organic matter, Cell volume, Plasma volume, Oxygen equivalent, Fat content, Chitin, Megaloplankton, Macroplankton, Mesoplankton, Microplankton, Ultraplankton, Squids, Salps, Flagellates.

In addition to the contributions to Plankton Symposium of 1957, the Committee on Terms and Equivalents defines measurements of primary production in the sea. The following general terms are defined: standing stock, production, turnover rate, primary productivity, gross primary production. Common definitions are suggested for biomass, displacement volume, settling volume, dry plankton, dry organic matter, cell volume, plasma volume. The following equivalents are recommended as useful for phytoplankton: carbon, dry organic matter, dry plankton, oxygen equivalent, and biomass. Counts of phytoplankton cells should be accompanied with data for conversion to weight or volume. The relationship between chlorophyll and total organic matter is variable and therefore chlorophyll should be used with caution to measure the phytoplankton standing crop; the use of chlorophyll as an indicator of productive capacity is not yet proven. Protein (or nitrogen) should be used prudently because its relationship to total organic matter is variable. The following equivalents are recommended for zooplankton: carbon, nitrogen, phosphorus, protein, dry plankton, biomass, and displacement volume. The plankton are classified according to their size and the characteristics of the species composition are given. (Jones-Wisconsin)
W70-05371

THE COMMUNITY CONCEPT IN MARINE ZOOLOGY, WITH COMMENTS ON CONTINUA AND INSTABILITY IN SOME MARINE COMMUNITIES: A REVIEW,
Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography.
Eric L. Mills.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1415-1428, 1969. 1 fig, 1 tab, 31 ref.

Descriptors: *Marine animals, *Aquatic life, Reviews, Biota, Dynamics, Publications, Documentation.
Identifiers: *Marine zoology, *Continua, Community concept, Literature review, Dynamic stability, Species constancy, Instability.

The history of the community concept in ecology is long and complex. Controversies regarding this concept have been most common in plant ecology, where the community has been variously regarded as an abstraction based either on a mosaic of vegetation or on independent continuous distributions of species (continua), or as a concrete, quantifiable unit. The analogy between communities and organisms is common, but the analogy must remain loose. Many ideas and terms used by marine ecologists appear to have been borrowed freely and uncritically from plant ecology. The classification of marine biomes is an example of an almost meaningless, overly-simplified synthetic system based on plant ecology. Such usually-accepted community criteria as species constancy and dynamic stability may not have relevance in marine situations. A variety of complex ecological assemblages exist, ranging from loosely integrated aggregations, to continua, to highly stable coadapted groups which are in equilibrium with environmental factors over long periods of time. A community is defined as 'a group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and separable by means of ecological survey from other groups.' (Voigtlander-Wisconsin)
W70-05393

TECHNICAL SERVICES FOR URBAN FLOODPLAIN PROPERTY MANAGERS: PROBLEM FORMULATION AND STUDY OF PROPERTY MANAGER RECEPTIVITY,
Northwestern Univ., Evanston, Ill.
For primary bibliographic entry see Field 04C.
W70-05443

PROGRESS IN DEVELOPING AN INFORMATION SYSTEM TO DISSEMINATE CURRENT WATER RESOURCE SCIENTIFIC INFORMATION,
Water Resources Scientific Information Center, Washington, D.C.
For primary bibliographic entry see Field 10.
W70-05458

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
Wyoming Univ., Laramie. Water Resources Research Inst.
Paul A. Rechard, William N. Embree, and Lee W. Larson.
Available from the Clearinghouse as PB-190 789, $3.00 in paper copy, $0.65 in microfiche. University of Wyoming Water Resources Research Institute Series 13, State Water Plan Report No. 1 - Revised, January 1970. 73 p.

Descriptors: *Computer programs, *Data processing, *Data storage and retrieval, *Streamflow, *Surface waters, Annual discharge, Automation, Duration curves, Frequency analysis, Hydrologic data, Information retrieval, Maximum flow, Mean daily flow, Minimum flow, Water resources, Water year.

A general description of a computerized system for Wyoming Surface Water Records is given. This system, developed by the University of Wyoming's Water Resources Research Institute, in conjunction with the Computer Center, is designed to store and utilize streamflow data. All available programs and types of output are described and procedures for operation of the system are given.
W70-05464

ESTIMATING THE GROUND-WATER CONTRIBUTION TO STORM RUNOFF BY THE ELECTRICAL CONDUCTANCE METHOD,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02A.
W70-05481

EXPERIMENTAL LARGE-SCALE SNOW AND ICE MAPPING WITH COMPOSITE MINIMUM BRIGHTNESS CHARTS,
National Environmental Satellite Center, Washington, D.C.
E. Paul McClain, and Donald R. Baker.
Environmental Science Services Administration Technical Memorandum NESCTM 12, September 1969. 19 p, 7 fig, 17 ref.

Descriptors: *Remote sensing, *Aerial photography, *Satellites (Artificial), *Data processing, *Mapping, Albedo, Snow, Ice, Clouds, Meteorology, Synoptic analysis, Climatology, Topography, Vegetation.
Identifiers: Brightness charting.

The Composite Minimum Brightness (CMB) chart is a computer product derived from digitized and rectified satellite video data. The minimum brightness values mapped over an area during a given period are composited and displayed as a means of suppressing transient cloudiness and enhancing major snow and ice features in the satellite imagery. Examples are presented, and limitations and verification of the technique are discussed. (Knapp-USGS)
W70-05522

08. ENGINEERING WORKS

8A. Structures

UNSTEADY FLOW OF DILUTE AQUEOUS POLYMER SOLUTIONS IN PIPE NETWORKS-A METHOD TO IMPROVE WATER DISTRIBUTION,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
Henry C. Jackson, and Paul G. Mayer.
Available from the Clearinghouse as PB-190 488, $3.00 in paper copy, $0.65 in microfiche. Jan 1970. Water Resources Center, Georgia Institute of Technology. WRC-0170, January 1970. 134 p, 3 tab, 41 fig, 83 ref, 3 append. OWRR Project A-016-GA.

Descriptors: *Aqueous solution, *Pipe networks, *Polymer additives, *Unsteady flow, *Flow resistance, *Fluid friction, Polymer interfaces, Pipelines, Hydraulic systems, Hydraulic conduits, Flow rates, Water works, Mathematical models.

The purpose of the research was to determine the effect of polymer additives in the flow of water in pipe networks. The use of friction-reducing additives to temporarily improve water distribution systems during emergencies is investigated mathematically and studied experimentally. The research was directed primarily to the prediction of the unsteady flow conditions which result from the injection locally of a long-chain polymer into a pipe network during emergency flow conditions. A computer program is developed to solve the equations associated with the unsteady flow in the network resulting from the additive. The program is used to show that an inadequate existing water distribution system for fire-fighting can be made adequate quickly enough by injection of a friction-reducing long-chain polymer at one point in the system. The report contains 41 illustrations and 83 references. (Conway-Georgia Tech)
W70-05120

TRENDS IN THE DESIGN AND CONSTRUCTION OF DAMS,
R. G. T. Lane, R. Marwick, and P. A. A. Back.
Civ Eng Pub Works Rev, Vol 64, No 760, p 1098-1105, Nov, 1969. 5 p, 7 fig, 6 ref.

Descriptors: *Dams, Damsites, *Dam construction, *Dam design, Rockfill dams, Dam foundations, Earth dams, Concrete dams, Cutoffs, Construction, Methodology, Concrete technology, Embankments, Seismic design, Design, Foundations, Foreign design practices.
Identifiers: *Design improvements, Construction methods, Construction practices, Construction control, Design practices, Great Britain.

Dams have increased in size over the years, and design techniques and construction plant and methods have developed in step. Major trends for earth dams are: (1) construction on deep permeable foundations permitted by development of alluvial grouting techniques and by use of impervious reservoir blankets and pressure relief wells; (2) cutoffs consisting of relatively large trapezoidal trenches backfilled with rolled earthfill or, in soft ground, concrete or clay placed in a narrow trench supported by bentonite slurry; (3) densification of loose permeable foundations by vibroflotation; (4) construction on weak clay foundations by controlling consolidation; and (5) minimizing risk of core cracking by using wider cores, more plastic materials, and compacting wet of optimum. Main developments in embankment construction have been the control of pore pressure, processing of granular material, and use of rockfill in compacted layers. Major trends for concrete dams are: (1) more comprehensive design techniques; (2) more attention to foundation investigation and design; (3) temperature control of concrete; (4) increase in maximum size of aggregate; (5) higher allowable concrete stresses; and (6) precautions against pore pressure buildup in foundations. (USBR)
W70-05225

STRESSES AND DISPLACEMENTS AROUND A CIRCULAR TUNNEL IN A THREE-LAYER MEDIUM-- I AND II,
Columbia Univ., New York.
R. K. Agarwal, and S. H. Boshkov.
Int J Rock Mech Mining Sci, Vol 6, No. 6, p 519-540, Nov 1969. 22 p, 13 fig, 12 tab, 19 ref.

Descriptors: Stress, Strain, Stress analysis, Stress concentration, *Stress distribution, *Displacements, Deformation, Tunnel design, Tunnel pressures, Homogeneity, *Tunnels, Rock mechanics, Elastic theory, Youngs modulus, Computer programs, Bibliographies, Theoretical analysis.
Identifiers: *Finite element method, *Similitude, Plane strain, Stress relaxation, Comparative studies.

The finite element method is used to analyze stress and displacement distributions around a circular tunnel, located in a layer of soft material and surrounded by layers of hard material for different values of the ratio of the height of soft layer to tunnel diameter. Results are compared to available experimental data. For overburden pressure, nonhomogeneity reduced the stress level along the horizontal and vertical axes. High seam pressure may change the magnitude and sign of the stress concentration along the horizontal axis and increase values of stress concentration along the vertical axis. Stress concentration decay rates for homogeneous materials may be different than for layered media. The principle of similitude is applied to stress distributions and displacements around a circular opening located in a continuous linear nonhomogeneous material. Stress distributions and displacements in the linear nonhomogeneous material were significantly different from those in a homogeneous material for identical loading conditions. Stress and displacement fields under the plane stress and plane strain hypotheses were compared for 2 values of the ratio of Young's moduli and differed significantly for high ratios. (USBR)
W70-05232

STRENGTHENING OF JOHN HOLLIS BANKHEAD DAM,
Corps of Engineers, Mobile, Ala.
Frederick G. Thompson.
Civ. Eng, Vol 39, No 12, p 75-78, Dec 1969. 4 p, 2 fig, 2 photo, 1 tab.

Descriptors: *Concrete dams, Corrosion control, *Anchors, Field tests, Grouting, Gravity dams, Rehabilitation, Installation, *Post tensioning, Spillways, Stressing cables, Wire.
Identifiers: *Dam stability, Corrosion tests, Comparative studies, Construction methods, Spillway piers, Anchor cables.

A gated concrete gravity overflow spillway section was strengthened by posttensioned foundation anchors at the potentially unstable John Hollis Bankhead Dam in Alabama. Working from a gallery located near the crest and extending the entire length of the dam, steel-wire anchors were placed in holes drilled through the dam and deep into the foundation. The bottom 30 ft of the anchors were grouted and allowed to set for 21 days before loading. After loading and checking, the remainder of each hole was grouted. Excellent results were obtained at a fraction of what replacement of the structure would have cost. Details of the anchors, installation, and testing are described. Anchors were also used in the right abutment and spillway piers. (USBR)
W70-05242

TARBELA--THE LARGEST DAM IN THE WORLD.

Water Resources Journal, p 13-21, June 1969. 11 p, 2 map.

Descriptors: Project benefits, Project planning, River basins, Rivers, Project purposes, Foreign projects, *Multiple-purpose projects, Outlet works, Rock fills, River basin development, *Earth dams, Hydroelectric plants, Spillways, Hydroelectric power, Hydraulic structures, Impervious blankets, *Large structures, Reservoirs, Irrigation water.
Identifiers: *Tarbela Dam (Pakistan), West Pakistan, Outlet tunnels, Superlative.

Need for huge quantities of irrigation water, indispensable to the economy of the country, and increasing demands for electrical power prompted the start of the Tarbela Dam project on the Indus River in West Pakistan. The project consists of the main dam, a reservoir blanket, 2 auxiliary dams, service and auxiliary spillways, 4 tunnels, and a powerhouse. The dams will be of earth and rockfill construction. The main dam will be 9000 ft long at the crest, 485 ft high, and will have a volume of about 139 million cu yd. The reservoir blanket and auxiliary dams will each have volumes of about 20 million cu yd. Total fill required is estimated at 185 million cu yd, making Tarbela the largest dam in the world. The spillways are conventional overflow crests controlled by sixteen 50- by 58-ft radial gates. The 4 tunnels will be about one-half mile long. Upstream from the service gates, the tunnels will have concrete linings and a diameter of 45 ft. Downstream, the tunnels will be steel lined and 3 will be 43.5 ft and one 36 ft in diameter. Ultimately, the power installation will consist of twelve 175-mw generating units. Circumstances leading to the need for the project, project benefits, reservoir silting problems, and problems of land acquisition and population resettlement are discussed. (USBR)
W70-05244

DESIGNING TO SUIT THE SOUTHERN NEVADA ENVIRONMENT,
Bureau of Reclamation, Denver, Colo.
Robert R. Rising, and Gayle A. Erickson.
Prepr 997, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct 1969. 36 p, 11 fig.

Descriptors: *Environment, Design, Nevada, Recreation facilities, Rock mechanics, *Pumping plants, *Environmental engineering, Rock bolts, Road design, Water treatment, Architecture, Pumping, Precast concrete, Tunnel design, Blasts, Structural design, Creativity, *Aesthetics, Landscaping.
Identifiers: Lake Mead, Piercing (Lakes), Raise boring, Presplitting, Blasting.

The Bureau of Reclamation has developed designs for the Southern Nevada Water Project that will protect the environment. This project is located in an area with recreational and scenic values attracting many visitors. A major problem was designing the plant to pump water from Lake Mead for project use. The designs involved rock mechanics, rock excavation for underground construction, piercing the lake at a point 100 ft below the surface, raise boring, and precast and prestressed concrete structural elements. Grouted rock bolts were used to mobilize the inherent rock strength, preventing future rockfalls. The controlling architectural concept was that the structures would blend with the natural setting. Concealment and camouflage were avoided. (USBR)
W70-05253

DESIGN OF STABLE OPEN CHANNELS USING CRITICAL TRACTIVE-FORCE CONCEPT,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-05298

FOUNDATIONS AND SUBSURFACE STRUCTURES IN SNOW,
Army Terrestrial Sciences Center, Hanover, N.H.
Malcolm Mellor.
Available from the Clearinghouse as AD-699 336, $3 in paper copy, 65 cents in microfiche. Cold Regions Science and Engineering Monograph III-A2c, October 1969. 63 p, 57 fig, 31 ref. DA Project 1 T062112A130.

Descriptors: *Snow, Construction, *Foundations, Design, Loads (Forces), Underground structures, Stress, Deformation, Strain, Creep, Elasticity, Ice, Pressure, Steel, Beams (Structural), Antarctic, Foundation investigations, Cold weather construction, Excavation, Mechanical properties.
Identifiers: Supports, Atmospheric temperature.

Various types of foundations suitable for use in very deep snow are described, and design principles are given. Dependence of settlement rate on heaving pressure, size and shape of foundation, snow temperature, and snow density is treated analytically, and field data from test procedures for foundation design are outlined. In treating the design of tunnels, shafts and subsurface structures in very deep snow, the distributions of stress, strain and displacement in polar ice sheets are first obtained analytically. Observed patterns of deformation are given for a variety of excavations and deformable structures, and methods of analysis are put forward. The loading of restraining structures is discussed, and finally some notes on the monitoring and maintenance of subsurface structures are given.
W70-05302

ESTABLISHMENT OF STATE, COUNTY, AND CITY BRIDGE COMMISSIONS.
For primary bibliographic entry see Field 06E.
W70-05357

8B. Hydraulics

METHODS FOR SOLVING THE BOUNDARY LAYER EQUATIONS FOR MOVING CONTINUOUS FLAT SURFACES WITH SUCTION AND INJECTION,
Kansas State Univ., Manhattan.
V. G. Fox, L. E. Erickson, and L. T. Fan.
AIChE Journal, Vol. 14, No. 5, p. 726-736, 1968. 13 ref., 9 fig.

Descriptors: *Heat transfer, *Boundary processes, *Boundary layers, Air-water interfaces, Convection, Evaporation, Energy transfer, Turbulent boundary layers, Reynolds number, Momentum transfer, Mathematical studies, Velocity, Temperature.
Identifiers: *Laminar boundary layers.

Several new and modified methods for solving differential equations describing the laminar boundary layer behavior on a moving continuous flat sheet with suction and injection are presented. Results are obtained for a wide range of the injection parameter, f (0), at Prandtl and Schmidt numbers of 1, 10, and 100. Those methods which permit hand calculation of the properties of interest are compared using the numerical solutions of the boundary layer differential equations as the exact solutions. The new integral method of Hanson and Richardson, which gives results for the momentum thickness that deviate less than 2.2% from the exact values is recommended for predicting values of the momentum boundary layer parameters. The Von-Karman-Pohlhausen method, which was modified to account for suction and injection is most generally valid. This method gives acceptable values of the transfer coefficients for heat, mass, and momentum transfer for most of the values considered. (Novotny-Vanderbilt)
W70-05044

MASS TRANSFER THROUGH HORIZONTAL LIQUID FILMS IN WAVY MOTION,
California Univ., Berkeley.
S. L. Goren, and R. V. S. Mani.
AIChE Journal, Vol. 14, No. 1, January 1968, p. 57-61, 6 fig., 10 ref.

Descriptors: *Mass transfer, Boundary processes, Diffusion, Heat transfer, Waves, Vibrations, Turbulence, Mixing, Reaeration, Films, Dissolved oxygen, Air-water interfaces.
Identifiers: Wave action.

The effect of standing waves of controlled amplitude and frequency on the steady state rate of mass transfer through thin horizontal liquid layers is studied experimentally. The variables studied are the film thickness, the amplitude and frequency of the waves, and the spacing between the probes generating the waves. A bulk motion of complicated pattern known as drift is caused by the finite amplitude of the waves. The rate of mass transfer in the absence of imposed vibration is two to three times greater than that expected by molecular diffusion alone. Vibration increases the rate up to an order of magnitude or more, depending on the hydrodynamic conditions. The data at low frequencies are correlated by an expression of the form (i- (i sub o))/ (i sub diff) = KA (f to the 3/4th) (h to the 1/2) (L to the -1/2). (Novotny-Vanderbilt)
W70-05045

DENSITY INDUCED RETURN CURRENTS IN OUTLET CHANNELS,
Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
B. P. Rigter.
Journal of the Hydraulics Division, ASCE, Vol 96, No HY2, Proc. Paper 7086, p 529-546, February, 1970. 16 fig, 3 tab, 6 ref.

Descriptors: *Channel improvement, *Density currents, *Flow, *Hydraulics, *Return flow, Estuaries, Hydraulic models, Salinity, Water quality.

When a channel discharges freshwater into a basin filled with salt water an arrested salt water wedge will be developed. A return current of salt water develops from the basin to the mixing region. The theory of two-layer flows is applied to determine the maximum return current. When the equation defining the backwater curve of a homogeneous flow with zero bottom slope is integrated, it becomes a function of a1a2, thickness of layers 1,2, respectively; a, total depth, q, thickness of layer at any point, and (x1 - x2) the horizontal distance between two points. There are two possible shapes of the back water depending upon the sign of the numerator of the function within integral sign. When slopes become important, theory does not hold because of curved streamline. Non-dimensional graphs are given and measurements in nature and model show good agreement. It is concluded that return current is highly sensitive to the length-to-depth ratio and to the internal Froude number, (Fo), of the discharged water, and thus to the cross-sectional area. This theory can be applied where a sill separates two basins with water of different densities. Other technical applications are, when an outlet channel is to be designed for outlet sluices, the flow pattern resulting from the density differences can be computed approximately. When an outlet channel is to be designed for cooling-water outlets, so that the water released into the basin has as low temperature as possible, the channel should be so designed that the internal Froude number will be low. Air currents can be used in river mouths as pneumatic barriers to prevent salt water intrusion. (Upadhyaya-Vanderbilt)
W70-05046

GRAPHICAL SOLUTION OF HYDRAULIC JUMP,
Utah State Univ., Logan. Dept. of Civil Engineering.
Roland W. Jeppson.

ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7014, p 103-108, January 1970. 6 p, 2 fig, append.

Descriptors: *Hydraulic jump, *Open channel flow, Froude number, Roughness (Hydraulic), Surges, Water levels, Standing waves.
Identifiers: Nomographs.

Nomograms are developed to give complete graphical solutions to the implicit hydraulic jump equation for flow in trapezoidal and triangular channels as well as the explicit equation for an hydraulic jump in a rectangular channel. The nomograms were constructed by combining alignment charts which solve the linearized components of the equation to graphical plots containing a graphical representation of the nonlinear components of the equation. (Knapp-USGS)
W70-05060

LIMIT SLOPE IN UNIFORM FLOW COMPUTATIONS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
Nagar S. Lakshmana Rao, and Kalambar Sridharan.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7011, p 95-102, January 1970. 8 p, 3 fig, 1 ref, append.

Descriptors: *Uniform flow, *Slopes, *Open channel flow, Froude number, Channel morphology, Discharge (Water), Water levels, Roughness (Hydraulic), Mathematical studies.
Identifiers: Limiting slopes (Uniform flow).

A method to prepare design charts for uniform flow in open channels is presented by introducing the concept of limit slope which is the smallest critical slope for a given channel shape and roughness. Equations are obtained for limit slope in rectangular, parabolic, and circular channels. The condition for limit slope in trapezoidal channels is given and it is shown that no limit slope exists for Z more than 0.5. The design chart correlating the Froude number, discharge, depth of flow and bed slope is presented for rectangular, parabolic, and trapezoidal channels. It is shown that for a given bed slope, width and roughness, the maximum Froude number in rectangular channels always occurs at a depth equal to 1/6 the width and a simple expression is given for its value. (Knapp-USGS)
W70-05061

NUMERICAL METHOD OF COMPUTING FLOW PROFILES,
Indiana Dept. of Natural Resources, Indianapolis. Surface Water Section.
Ramanand Prasad.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY 1, Paper 7005, p 75-86, January 1970. 12 p, 4 fig, 1 tab, 7 ref, 3 append.

Descriptors: *Computer programs, *Flow profiles, *Gradually varied flow, Hydraulics, Backwater, Streamflow, Open channel flow, Digital computers, Water levels.
Identifiers: Flow profile computation.

A simple rapidly converging iterative method of computing gradually varied steady flow profiles in open channels of any shape, prismatic or nonprismatic, is presented. The method is also applicable to spatially varied steady flow. It is not necessary to determine the shape of the expected profile or the type of flow in advance to proceed with the solution. Computations can proceed either upstream or downstream, regardless of the type of flow, once the channel, discharge, and the initial depth of flow are specified. The procedure for hand computation is illustrated by an example and a Fortran program is given. (Knapp-USGS)
W70-05062

NUMERICAL SOLUTION OF SAINT-VENANT EQUATIONS,
California Univ., Davis. Dept. of Water Science and Engineering.
Theodor Strelkoff.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, no HY1, Paper 7043, p 223-252, January 1970. 30 p, 5 fig, 30 ref, append.

Descriptors: *Gradually varied flow, *Open channel flow, *Equations, *Unsteady flow, *Mathematical studies, Computers, Canals, Waves (Water), Hydraulics, Mathematical models.
Identifiers: Saint-Venant equations.

The general, one-dimensional Saint-Venant equations are presented for a rigid open channel of arbitrary form, not necessarily prismatic, containing a flow that may be spatially varied. The theoretical basis for the method of characteristics is reviewed and used to show that in the general case the speed of long-wave disturbances is given by the slope of the characteristic curves. Finite-difference schemes on a rectangular net in the x - t plane and based on the characteristic forms of the Saint-Venant equations as well as on the direct forms are given and examined for their stability. The vov Neumann technique for stability analysis is presented in detail. Explicit numerical schemes, which are simple, but require small steps in time because of stability problems, are contrasted with implicit schemes that permit numerical solution over large time steps but require the solution of large sets of simultaneous algebraic equations at each step. The double-sweep or 'progonka' method, an exact time-and-space-saving technique for solving these (locally linearized) equations is also given in detail. (Knapp-USGS)
W70-05063

MANNING FORMULA -- A MISNOMER,
Geological Survey, Washington, D.C. Water Resources Div.
Garnett P. Williams.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7036, 193-200, January 1970. 8 p, 35 ref.

Descriptors: *Mannings equation, *Reviews, *Bibliographies, Evaluation, Open channel flow, Discharge coefficients, Streamflow, Roughness (Hydraulic), Discharge (Water).

No one ever proposed the popular Manning formula in the form commonly used today. At least ten papers, beginning with that of Gauckler in 1867, offered a monomial equation for certain flow conditions. Manning's paper, 1891, was the fifth, chronologically, in this group of papers. The Frenchman Flamant is primarily responsible for first attributing the formula to Manning and for introducing the resistance coefficient n. H. T. Bovey is known to have been, in 1901, the first to write the equation in the form used today for English units. The expression 'Manning's n' first crept into the literature in 1916 and represented a rather ironic development, as Manning had clearly rejected the use of the coefficient n. (Knapp-USGS)
W70-05064

COMPUTATIONAL PROCEDURES FOR FLOW RESISTANCE LAWS,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 07C.
W70-05127

HOT-FILM TURBULENCE MEASUREMENTS IN WATER FLOW,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 07B.
W70-05128

INTEGRATING-FLOAT MEASUREMENTS IN TURBULENT FLOWS,
Missouri Univ., Columbia. Dept. of Civil Engineering, and Public Health Service, Columbia, Mo.
For primary bibliographic entry see Field 07B.
W70-05140

CHANNEL SLOPE EFFECT ON PEAK DISCHARGE OF NATURAL STREAMS,
Washington Suburban Sanitary Commission, Hyattsville, Md., and Greenhorne and O'Mara, Inc., Riverdale, Md.
For primary bibliographic entry see Field 02E.
W70-05141

CHARACTERISTICS OF SELF-AERATED FLOWS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
Nagar S. Rao Lakshmana, Kyatasandra Seetharamiah, and Thimmaiah Gangadharaiah.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7055, p 331-355, February 1970. 25 p, 11 fig, 3 tab, 16 ref, append.

Descriptors: *Open channel flow, *Air entrainment, *Aeration, Turbulent flow, Mixing, Model studies, Hydraulic models, Air, Dispersion, Eddies, Vortices.
Identifiers: Self-aerated flows.

Characteristics of self-aerated flows in open channels are studied by dividing the flow into two zones: (1) wall turbulent zone; and (2) free turbulent zone. Theoretical equations developed for air concentration and velocity in the free turbulent zone, starting from the basic equations of motion and continuity are checked with experiments conducted in a tilting flume and the agreement between them is shown to be good. The terms air-water density and air-water velocity are defined and equations are presented correlating them with air concentration. In accordance with the new delfinitions, Halbronn's method of measuring air-water velocity is modified and used in the investigations. An empirical relationship between bulkage depth and mean air concentration is presented. (Knapp-USGS)
W70-05143

RIPPLE CONCENTRATION AND FRICTION FACTOR,
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
Fred F. M. Chang.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7067, p 417-430, February 1970. 14 p, 8 fig, 1 tab, 22 ref, append.

Descriptors: *Open channel flow, *Alluvial channels, *Ripple marks, *Sand waves, *Roughness (Hydraulic), Flow resistance, Hydraulics, Fluid friction, Bed load, Turbulent flow, Turbulence.
Identifiers: Ripple concentration.

Flow over ripples in alluvial channels is essentially the same as the flow over rigid roughness elements, the main difference lying only in the shapes of the ripples and roughness elements. The total friction factor is the summation of grain-roughness friction factor and form-roughness friction factor. Nikuradse's formula for grain-roughness friction factor is found to be satisfactory in determining the value of grain-roughness friction factor for the flow in alluvial channels. The form-roughness friction factor is proportional to the 'exposure parameter' and inversely proportional to mean relative height of the ripples. It is also proportional to the coefficient of expansion loss, which is found to be a function of the mean relative height of the ripples. (Knapp-USGS)
W70-05154

VERTICAL TRANSFER IN OPEN CHANNEL FLOW,
Geological Survey, Fort Collins, Colo.; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.

Harvey E. Jobson, and William W. Sayre.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7148, p 703-724, March 1970. 22 p, 15 fig, 1 tab, 16 ref, append.

Descriptors: *Open channel flow, *Dispersion, *Mixing, *Turbulent flow, *Path of pollutants, Turbulence, Sedimentation, Settling velocity, Mass transfer, Dye releases, Hydraulic models, Hydraulics, Model studies, Tracking techniques, Tagging, Roughness (Hydraulic).
Identifiers: Turbulent dispersion.

Vertical turbulent mass transfer coefficients for suspended sediment particles and dye, and fall velocities of the sediment particles were determined experimentally in a large laboratory flume. Local values of the turbulent mass transfer coefficient, and turbulent fall velocities for the sand, were determined from an integrated form of the transfer equation. The results of the experiments indicate that: (1) Magnitude and distribution of the vertical turbulent mass transfer coefficient for dye and fine sediment are close to those of the momentum transfer coefficient, which lends added support to Reynolds' analogy for the equivalence of mass and momentum transfer in turbulent shear flow; (2) in comparison with dye, the mass transfer coefficient for medium sand is somewhat less in magnitude and its distribution indicates that the transfer coefficient is larger near the bed; and (3) the fall velocity of sediment particles is larger in turbulent channel flow than in quiescent water. (Knapp-USGS)
W70-05160

MACROTURBULENT FLOW IN STEEP OPEN CHANNELS WITH HIGH NATURAL ROUGHNESS,
Fritz Hartung, and Helmut Scheuerlein.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A1, p 1-8, 1967. 8 p, 6 fig.

Descriptors: *Turbulent flow, *Open channel flow, *Model studies, *Hydraulic models, Turbulence, Roughness (Hydraulic), Roughness coefficient, Supercritical flow, Channel morphology, Mixing.
Identifiers: Macroturbulent flow.

Macroturbulent flow in open channels was studied in laboratory flumes. Macroturbulent flow is characterized by steep slope, large roughness, relatively small discharge, and forced mixing with air. By considering only the component in the main direction of flow, no agreement with well-known flow formulas could be achieved even taking into account the entrained air by working with a lower density of the air-water mixture. This discrepancy is certainly a consequence of the high-grade turbulence which is superimposed on the main flow direction. Formulas describing this type of flow were tried using 2 different analyses of the measurements. One of them leads to a simple resistance function by assuming imaginary velocities. (Knapp-USGS)
W70-05189

A STUDY OF THE ROUGHNESS OF CONCEPTUAL RIVER SYSTEMS OR WATERSHEDS,
Missouri Univ., Rolla. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Hydraulic Engineering.
T. E. Harbaugh, and Ven Te Chow.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A2, p 9-17, 1967. 9 p, 8 fig, 11 ref.

Descriptors: *Roughness (Hydraulic), *Roughness coefficient, *Mathematical models, Model studies, Equations, Overland flow, Runoff, Routing, Rainfall-runoff relationships, Raindrops.
Identifiers: *Watershed models, Watershed roughness.

The roughness of a conceptual river system or watershed is investigated by mathematical formulation and laboratory experimentation. By mathematical formulation, the watershed is considered as a quasi-linear distributed dynamic system. The hydraulic behavior of this system representation is described by a set of quasi-linear partial differential equations of continuity and momentum equations which define the spatially varied unsteady flow. The conceptual watershed is composed of the overland flow part and the main channel flow part. The equations are first applied to the overland flow phase due to input rainfall and then to the main channel flow phase using the overland flow as input. Solution of the equations is made in their finite-difference forms on digital computers. The friction slope in the energy equation is expressed by a conceptual measure of the watershed roughness. This conceptual roughness is further evaluated in a laboratory study of the watershed in various shapes and slopes and its sensitivity to depth of flow and raindrop impact on the laboratory watershed is disclosed. (Knapp-USGS)
W70-05190

UNIFORM FLOW IN IDEALIZED CHANNEL-FLOOD PLAIN GEOMETRIES,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
J. W. Delleur, G. H. Toebes, and B. C. Udeozo.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A27, p 218-225, 1967. 8 p, 2 fig, 1 tab, 5 ref. USDA Contract No 12-14-100-8895 (41).

Descriptors: *Flood routing, *Open channel flow, *Channel morphology, *Flood plains, *Hydraulic models, Model studies, Reynolds number, Hydraulic similitude, Alluvial channels, Routing.
Identifiers: Flood plain model.

The growing intensity of land and water resources utilization has renewed efforts towards systematic research in the field of fluvial hydraulics. The flow through a prismatic channel-flood plain geometry is a necessary bounding condition to the cases of river channel nonuniformity. Experiments were made using three channel geometries, each consisting of a small rectangular channel, as the main river channel, connecting to a much wider rectangular channel on top, as the flood plain. The models were made of varnished plywood. In one of the geometries, the flood plain section was lined with an expanded metal mesh to simulate the condition in natural rivers where the roughness coefficient of the flood plain is much higher than that of the main channel. For each geometry, nine flow conditions were tested. The Froude numbers varied from 0.34 to 1.38 and the slopes varied from 0.00067 to 0.00378. Detailed velocity distributions were taken from which lines of equal velocity were obtained. When the flood plain is not very wide compared to the main channels, there is a substantial interference between the two flows. On the contrary, when the flood plain is wide compared to the main channel, there is little interference between the two flows. The results of the investigation of energy losses indicate that the Darcy-Weisbach friction coefficient decreases with the Reynolds number, and increases with the hydraulic radius. (Knapp-USGS)
W70-05191

RECOGNITION OF SCOUR OF RIVER CHANNEL FOR DESIGN PURPOSES,
Corps of Engineers, Kansas City, Mo.
Gerald B. Swanson.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A15, p 115-122, 1967. 8 p, 4 plate, 1 tab.

Descriptors: *Scour, *Erosion, *Alluvial channels, Rivers, Hydraulics, Roughness (Hydraulic), Stage-discharge relations, Manning equation, Backwater, Open channel flow, Channel morphology.
Identifiers: Scour prediction.

Backwater computation to determine the design water surface for protective works is based on fixed cross sections obtained from hydrographic surveys usually taken during periods of low flow. A comprehensive study of these cross sections and ones obtained at identical locations by sonic soundings during flood show that marked changes of depth and section occur with increased stage and discharge. The main channel flow is analyzed and the effect of section change, bed material size, and other factors are assessed by using a variable roughness coefficient 'n' as it is used in the Manning equation for backwater computations. (Knapp-USGS)
W70-05199

SOME EXPERIMENTAL OBSERVATIONS ON FREE SURFACE SHEAR FLOW OVER A WAVY BOUNDARY,
Ecole Polytechnique, Montreal (Quebec); and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Luc Robillard, and John F. Kennedy.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A6, p 41-48, 1967. 8 p, 4 fig, 2 tab, 4 ref.

Descriptors: *Supercritical flow, *Open channel flow, *Waves (Water), Standing waves, Currents (Water), Velocity, Turbulence, Model studies, Hydraulic models, Laboratory tests, Roughness (Hydraulic).
Identifiers: Kinematic waves.

Laboratory experiemtns on supercritical flow over rigid beds of sinusoidal form in a rectangular cross-section channel revealed the existence of oblique, stationary surface waves, one wave emanating from each bed wave. Measurements of velocity distributions traced the origin of these waves to periodic variations in the displacement thickness of the boundary layers of the vertical walls of the test section. Predictions of the inclination of these waves from kinematical considerations are found to be in good agreement with measured values. The variations in the displacement thickness are explained in terms of induced secondary currents arising from centrifugally generated pressure distributions and convective acceleration of the retarded fluid near the flume walls. The form of the velocity profiles both outward from the lateral walls and upward from the bed was found to vary widely along a bed wave. (Knapp-USGS)
W70-05202

RESISTANCE TO FLOW IN FIXED-BED CHANNELS WITH THE INFLUENCE OF CROSS-SECTIONAL SHAPE AND FREE SURFACE,
Genoa Univ. (Italy). Inst. of Hydraulics.
Enrico Marchi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A5, p 32-40, 1967. 9 p, 7 fig, 10 ref.

Descriptors: *Open channel flow, *Closed conduit flow, Turbulent flow, Mathematical models, Roughness (Hydraulic), Turbulent boundary layers, Hydraulic models.
Identifiers: Fixed-bed channels.

The analytical transfer of the velocity and resistance laws from circular pipes to closed-conduits of general cross-sectional configuration and to open channels, meets the known difficulties which are due to the non-uniform distribution of the wall shear stress and, in the latter case, due also to the free surface influence. The study is approached by introducing a new expression of the velocity distribution along normals to the wall. This law, which contains the logarithmic one as a limit-law in the wall region, appears to be substantially justified by the experimental observations. From it, following a classic pattern, the resistance laws are deduced.

The possibility of interpreting the effect of section shape, and also the free surface influence in open channels, are shown with the introduction of only one shape coefficient, which appears as a multiplier of the hydraulic radius. Results of tests on channels with homogeneous and nonhomogeneous roughness, conducted in 1957-1960 gave some values of the shape coefficient. (Knapp-USGS)
W70-05203

HYDRAULIC RESISTANCE OF A MOVABLE CHANNEL BED AND SEDIMENT GRADING INFLUENCE,
Akademiya Nauk Armyanskoi SSR, Erevan.
For primary bibliographic entry see Field 02J.
W70-05206

WATER HAMMAR ANALYSIS,
Michigan Univ., Ann Arbor.
Victor L. Streeter.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY6, p 1959-1972, Nov 1969. 14 p, 12 fig, 3 ref, 2 append.

Descriptors: *Water hammer, Computers, Flow control, Fluid flow, Fluid friction, Hydraulics, Pipe flow, Transients, *Digital computers, Failure (Mechanics), Computer programming, Pipelines, Friction, *Analysis, Vapor pressure, Velocity, Discharge (Water), Pumps, Hydrodynamics, Equations.
Identifiers: Boundary conditions, Method of characteristics, Transient flow.

Digital computer methods have been replacing graphical methods of water hammer analysis. Simplified methods of calculating hydraulic transients are given with techniques for increasing the computing time interval over that permitted by the characteristic method. Lumping and interpolation methods are compared with mixed implicit and characteristic methods. Complex boundary conditions are examined, including a springmass system with coulomb friction, an accumulator with inertia and fluid friction, pump failures, and column separation. (USBR)
W70-05233

A UNIFORM FLOW FORMULA FOR FLUMES AND CANALS,
Mississippi State Univ., State College.
Brahm P. Verma, and John C. McWhorter.
Pap 69-746, Amer Soc Agr Eng 1969 Winter Meet, Chicago, Ill, Dec 1969. 19 p, 4 fig, 3 tab, 7 ref.

Descriptors: *Uniform flow, *Equations, *Flumes, *Canals, *Irrigation canals, Chezy equation, Turbulent flow, Laboratory tests, Concrete-lined canals, Hydraulics, Hydraulic models, Fluid flow, Fluid mechanics.
Identifiers: *Formulas, Concrete linings.

A dimensional analysis was made for the common case of uniform, turbulent flow. An experiment in a laboratory flume and the analysis of data obtained established a uniform flow formula applicable to data obtained from literature on uniform flow in flumes and large, concrete-lined irrigation canals. The study was conducted in 4 steps: (1) analyzing the problem dimensionally, (2) conducting a flume test for appropriate data collection, (3) analyzing data to establish a prediction equation that described uniform flow, and (4) comparing the prediction equation with data obtained from literature on uniform flow in flumes and fixed canals. (USBR)
W70-05234

BOUNDARY CONDITIONS FOR AIR CHAMBERS AND SURGE TANKS,
British Columbia Univ., Vancouver.
Eugene Ruus, and M. Hanif Chaudhry.
Trans Eng Inst Can, Vol 52, No 11, p 45-50, Nov 1969. 6 p, 10 fig, 6 ref, append.

Descriptors: *Water hammer, Fluid mechanics, *Surge tanks, Digital computers, *Air chambers, Pressure head, Flow control, Fluid friction, Fluid flow, Hydraulics, Transients, Analysis, Vapor pressure, Foreign research, Velocity, Discharge (Water), Differential equations, Unsteady flow, Pumps, Wave velocity, Pipelines.
Identifiers: *Boundary conditions, Canada, Analytical method, Method of characteristics, Accuracy.

Air chambers or surge tanks are often provided on discharge lines to reduce water hammer caused by failure of a pump or by rapid closing or opening of a flow-regulating device. For long discharge lines having large head losses, air chambers are economical; surge tanks are preferred for short pipelines carrying large discharges. Either device should be connected to the pipeline as close to the source of disturbance as practicable. Equations of momentum and continuity of unsteady flow through closed conduits because of their nature have no possible solution. Graphical methods evolved are approximate and cannot be used for large, complicated systems. The method of characteristics for solving the continuity and momentum equations by a digital computer is more accurate and can be used for complicated pipe systems. Equations representing the boundary conditions for air chambers and surge tanks are given. (USBR)
W70-05239

EROSION AT THE BASE OF FLIP BUCKETS,
Winsor Univ. (Ontario).
For primary bibliographic entry see Field 02J.
W70-05245

HYDRAULIC PROPERTIES OF STREETS.
Los Angeles Dept. of Public Works, Calif.

Office Standard, No. 94, April 11, 1949 (Revised Oct. 5, 1950). 16 p, 17 fig, 1 tab.

Descriptors: *Hydraulic properties, *Hydraulic design, *Hydraulics, *Flow characteristics, *Hydraulic engineering, *Drainage engineering, *Surface drainage, *Paving, *Drainage practices, *Road design, Surface runoff.
Identifiers: *Street design, *Gutter design, *Hydraulic properties of streets, *Los Angeles, Municipal engineering.

The publication comprises a set of 10 charts which can be used to simplify the otherwise complicated mathematics involved in making computations of stormwater drainage flows and hydraulic properties of street and gutter sections. The charts were developed and published for use in the City Engineer's Office of Los Angeles. Collectively, the charts are designated as Office Standard No. 94 of the Storm Drain Division. Given the gutter slope, rate of stormwater flow (cfs), and the cross-fall of the street section, values of gutter flow-depth, width of gutter flow and flow velocity can be obtained from a single chart representative of the appropriate street and pavement widths. Alternatively, given the gutter flow-width, gutter slope, and cross-fall, values of gutter flow-depth and futter flow capacity (cfs) can be obtained from the same chart. Each chart is designed for a specific pavement width and street width, varying from 40 ft. to 100 ft. street widths. All charts are based on 8 inch curb heights. A chart for converting other heights is given. (Poertner-Chicago)
W70-05257

HYDRAULIC ANALYSIS OF JUNCTIONS,
Los Angeles Dept. of Public Works, Calif.
Donald Thompson, Irving R. Cole, and Floyd J. Doran.
Office Standard, No. 115, 1968. 37 p, 38 fig.

Descriptors: *Hydraulic design, *Hydraulics, *Flow characteristics, *Sewers, *Hydraulic engineering, *Hydraulic properties, *Head loss, *Junctions, Hydraulic gradient, Energy losses, Pipe, Open channels.
Identifiers: *Junction losses, *Hydraulic analysis of junctions, Los Angeles, Municipal engineering.

This monograph discusses the development and practical applications of a newly developed mathematical formula for use by engineers in computing energy and pressure losses at junctions of sewer pipes and open channels. The formula is based on the 'pressure plus momentum' theory which equates the summation of all pressures acting at a junction with the summation of the momentums. The use of the formula affords a rational method of analyzing hydraulic losses when designing either sanitary, storm, or combined sewer systems. The 'pressures' which must be evaluated are those at (1) upstream end of junction, (2) downstream end, (3) conduit wall, (4) invert, and (5) soffit. The general formula presented in this monograph simplifies calculations by making unnecessary the evaluation of these individual pressures. It is shown that, regardless of conduit shape, the summation of all pressures acting at the junction, ignoring friction, equals the average cross-sectional area through the junction multiplied by the change in the hydraulic gradient. The derivation of the formula is presented together with sample problems and solutions illustrating computations of hydraulic changes at junctions, for both subcritical and supercritical flows. (Poertner-Chicago)
W70-05258

HYDRAULIC PROPERTIES OF PIPE, BOXES, AND RECTANGULAR CHANNELS,
Los Angeles Dept. of Public Works, Calif.
Lyall A. Pardee.
Office Standard No. 116, 1966. 65 p.

Descriptors: *Hydraulic design, *Hydraulics, *Flow characteristics, *Hydraulic engineering, *Hydraulic properties, *Pipes, *Open channels, Energy gradient, Hydraulic gradient.
Identifiers: *Los Angeles, *Municipal engineering.

The monograph presents design formulas and tables for use by engineers engaged in designing and analyzing the flow of liquids through pipes. The publication is primarily intended for use in designing water conveyance conduits in sewer systems, water supply systems and irrigation systems. Various cross-sections of conduits are considered including circular pipe, box sections, and rectangular channels. The individual tables simplify flow computations that are based upon conventional, but complicated, formulae. All possible flow depths are included in the tables, in increments of 2, 3, or 6 inches, depending upon the size of conduit. The tables are based upon the assumption that 'uniform' flow conditions prevail. (Poertner-Chicago)
W70-05259

HYDRAULIC AND MIXING CHARACTERISTICS OF SUCTION MANIFOLDS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
For primary bibliographic entry see Field 05G.
W70-05468

RESISTANCE TO FLOW OVER TWO-DIMENSIONAL STRIP ROUGHNESS,
Roorkee Univ. (India). Dept. of Civil Engineering.
K. G. Ranga Raju, and Ramachandra J. Garde.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY3, Paper 7181, p 815-834, March 1970. 20 p, 10 fig, 1 tab, 17 ref, append.

Descriptors: *Roughness (Hydraulic), *Open channel flow, *Flow resistance, Model studies, Hydraulic models, Turbulent flow, Turbulence.
Identifiers: Wind tunnel studies.

Wind tunnel and open channel experimental data on the resistance of two-dimensional strip roughnesses kept on a plane boundary were analyzed. At low Froude number, in the range of

relative spacing from 2.5 to 40.0, the total (effective) resistance of the plane boundary can be taken as equal to the form resistance of the roughness elements. The resistance relation was put in the form of an empirical equation. Comparison of this equation with the conventional resistance equations for artificial roughness shows that the datum may be located at the level of the plane boundary for relative spacing less than 5.0 and should be located higher at smaller spacings, if the conventional equation is to be used. Large errors can result if the method proposed by Morris is used to predict the resistance in case of flow over strip roughnesses. (Knapp-USGS)
W70-05483

DYNAMIC EQUATIONS FOR STEADY SPATIALLY VARIED FLOW,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen, and Harry G. Wenzel, Jr.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY3, Paper 7179, p 801-814, March 1970. 14 p, 1 fig, 14 ref, 3 append.

Descriptors: *Open channel flow, *Unsteady flow, *Non-uniform flow, *Equations, Mathematical studies, Chezy equation, Darcy-Weisbach equation, Slopes, Mannings equation.
Identifiers: Spatially varied flow.

Dynamic equations for steady spatially varied flow in uniform channels are derived separately based on momentum and energy principles. It is shown that the momentum equation is inherently different from the energy equation. In general, six different gradients are involved in steady spatially varied flow: the friction slope in the momentum equation, the dissipated energy gradient in the energy equation, the total head gradient, the gradient of the piezometric head, the free surface slope, and the channel slope. Conventional practice of using the Manning, Chezy, or Weisbach formulas to evaluate the friction slope or the dissipated energy gradient is only an approximation. (Knapp-USGS)
W70-05484

DIFFUSION BELOW SUBMERGED RECTANGULAR OUTLETS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and D. Muralidhar.
Supported by the National Research Council of Canada. Journal of Hydraulic Research, Vol 7, No 2, p 251-274, 1969. 24 p, 14 fig, 2 tab, 12 ref.

Descriptors: *Open channel flow, *Jets, Hydraulics, *Outlets, Open channel flow, Turbulent flow, Hydraulic structures, Canals, Rivers, Channel morphology, Model studies, Hydraulic models.
Identifiers: Submerged outlets.

A number of hydraulic structures like river and canal outlets sometimes discharge under submerged conditions. For developing safe but economical designs for the energy dissipators for these outlet works, a good knowledge of at least the mean diffusion characteristics of the flow is necessary. An experimental study was made of part-width rectangular wall jets with an abrupt drop and part-width rectangular wall jets located with an eccentricity with respect to the center line of the downstream channel. (Knapp-USGS)
W70-05512

FLOW PHENOMENA NEAR ROUGH BOUNDARIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Emmett M. O'Loughlin, and V. S. Shastri Annambhotla.
Journal of Hydraulic Research, Vol 7, No 2, p 231-250, 1969. 20 p, 3 fig, 7 ref. ONR Contract Nonr-1509 (03).

Descriptors: *Turbulent flow, *Boundary processes, Roughness (Hydraulic), Hydraulics, Interfaces, Turbulence, Open channel flow, Closed conduit flow, Steady flow, Reynolds number, Laminar flow, Boundary layers, Model studies, Hydraulic models.
Identifiers: Eddy diffusion.

Velocity profiles of flows over boundaries covered with spaced roughness elements exhibit systematic departures from the logarithmic profile, departures which affect predictions of resistance and transfer processes occurring at a rough boundary. A model, based upon the apparent nature of the eddy diffusion coefficient, is used to develop an expression for velocity profiles close to rough boundaries. Observations in an air conduit and an open channel support the concept, suggested by dimensional reasoning, that the velocity distribution should be determined by a modified 'inner' law. The stability criterion of the viscous sublayer on the smooth boundary between roughness elements is evaluated. It is shown that the limiting sublayer Reynolds number is comparable to that obtained in smooth-pipe experiments. (Knapp-USGS)
W70-05517

FLOOD CONTROL CHANNEL HYDRAULICS,
Corps of Engineers, Los Angeles, Calif. Hydraulics Section.
Albert P. Gildea, and Ralph F. Wong.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A41, p 330-337, 1967. 8 p, 12 fig, 1 tab.

Descriptors: *Open channel flow, *Hydraulic design, *Flood control, Channel improvement, Floodways, Flumes, Turbulent flow, Flow resistance, Model studies, Hydraulic models.
Identifiers: High velocity open channel flow.

Concrete-lined open channels having a rectangular or trapezoidal cross section have become increasingly necessary and well justified to control floods for the protection of highly developed industrial and urban areas located on steep-gradient streams in the United States. Methods are described for resolving some of the problems encountered when high velocity flow traverses short radius curves in both rectangular and trapezoidal channels and when two high velocity tributary flows join at a confluence. Illustrations of prototype and model installations are given for designs used in the construction of flood control channels by the Corps of Engineers in Southern California. (Knapp-USGS)
W70-05523

A THEORY OF STABILITY OF STREAMS,
Nagoya Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-05524

ON A SOLUTION OF BED FLUCTUATION IN OPEN CHANNEL WITH MOVABLE BED OF STEEP SLOPE,
Kobe Univ. (Japan). Dept. of Civil Engineering.
Junzaburo Matsunashi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A44, p 354-361, 1967. 8 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Channel morphology, *Alluvial channels, Sediment transport, Regime, Mathematical studies, Model studies, Bed load, Dunes, Ripple marks, Roughness (Hydraulic).
Identifiers: Streambed form.

In open channel flow with steep movable bed, undulations such as anti-dunes, the wavy profiles of which propagate generally in the direction of upstream, are formed on the bed surface. The propagating velocity is very slow in general and the profiles are regular. The free surface of fluid moving throughout over the bed surface fluctuates according to the bed undulations, so that wavy profiles of the free surface propagate very slowly in the same direction as the profiles of the bed surface, and often the amplitudes increase together in size with distance in the direction of flow. With a critical wave size the wavy profiles of the bed surface may be flushed out by hydraulic jump. (Knapp-USGS)
W70-05526

ON THE VELOCITY COEFFICIENT AND HYDRAULIC ROUGHNESS IN MEANDERING WATERCOURSES,
Research Inst. for Water Resources Development, Budapest (Hungary). Dept. for Hydromechanics.
For primary bibliographic entry see Field 02E.
W70-05527

THE KINETIC ENERGY CORRECTION FACTOR AND THE MOMENTUM CORRECTION FACTOR IN OPEN CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
V. Strauss.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A39, p 314-323, 1967. 10 p, 4 fig, 4 ref.

Descriptors: *Open channel flow, *Kinetics, Momentum transfer, Turbulent flow, Channel morphology, Mathematical studies, Streamflow.
Identifiers: Kinetic energy correction factor.

The effect of the velocity distribution and section shape of open channels on the value of the kinetic energy correction factor and of the momentum correction factor is discussed. By introduction of dimensionless shape parameters of the channel and under the general assumption that the velocity distribution is vertical the equations for correction factors are derived. These are valid for the usual simple and combined channel sections. On the basis of the theoretical analysis of these equations the effect of the channel shape and velocity distribution are determined. The theoretical results and direct measurements in open flows confirm that the values of the correction factor are often much higher than the generally used values in the range 1.0 - 1.1. (Knapp-USGS)
W70-05528

CALCULATION PROCESS OF POLYGONAL CROSS-SECTION CANALS (FRENCH),
Youlouse Univ. (France). Institut de Mecanique des Fluides.
Yves Labye, and J. Nougaro.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A37, p 297-306, 1967. 10 p, 5 fig.

Descriptors: *Open channel flow, *Hydraulics, *Channel morphology, Mathematical studies, Mathematical models, Steady flow, Mannings equation.
Identifiers: Open channel hydraulics.

Calculation of steady flow in cylindrical canals, the cross section of which may be given by any polynomial, may be done by use of formulas identical to those used for trapezoidal canals. Very simple programs are proposed to be solved even by micro-computers, or by the use of very small tables, or abacus when circumstances prevent recourse to large computers. (Knapp-USGS)
W70-05529

A RECONSIDERATION OF THE HYDRAULIC RADIUS AS A GEOMETRIC QUANTITY IN OPEN CHANNEL HYDRAULICS,
Alabama Univ., Huntsville. Dept. of Fluid Mechanics; and Colorado State Univ., Fort Collins.
Cornelius C. Shih, and Neil S. Grigg.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A36, p 288-296, 1967. 9 p, 7 fig, 12 ref.

Descriptors: *Open channel flow, *Hydraulics, *Hydraulic radius, Turbulent flow, Steady flow, Model studies, Hydraulic models, Channel morphology.
Identifiers: Open channel hydraulics.

The validity of applying the hydraulic radius as a ole geometric quantity for various channel shapes in the computation of turbulent uniform flow is discussed. The flows in smooth rectangular channels of 0.24 ft. and 0.75 ft. in width were analyzed for aspect ratios ranging from about 0.5 to 10. The data collected from the two channels on mild and steep slopes are presented in graphical form and mostly through dimensionless parameters. The dimensionless parameters plotted are the friction factor, the Reynolds number, the modified Reynolds number and the aspect ratio of rectangular channels. For a given hydraulic radius, channel slope, and roughness, the increase in mean velocity of turbulent uniform flow or the decrease in flow resistance is attributed to the lowering aspect ratio. This trend toward less flow resistance appears to be more evident for the mild slope than the steep. The application of the hydraulic radius in the uniform flow analysis is valid within the limit of engineering accuracy if the aspect ratio is high (greater than about 2); the use of the hydraulic radius should be coupled with the consideration of the effect of channel shape if the aspect ratio is less than about a 2; the explicit knowledge of the effect of channel shape on the flow resistance needs to be further advanced so that a better uniform-flow formula may be made available; the relationship between the friction factor and the modified Reynolds number, is more convenient and recommendable for efficient use with the Darcy-Weisbach's uniform flow formula. (Knapp-USGS)
W70-05530

THE GRADUALLY VARIED FLOW IN NONPRISMATIC CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
T. Horsky.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A34, p 272-279, 1967. 8 p, 6 fig, 6 ref.

Descriptors: *Open channel flow, *Unsteady flow, *Equations, *Discharge (Water), Streamflow, Mathematical models, Stage-discharge relations.
Identifiers: Nonprismatic open channels.

The modification and integration of the differential equation for a gradually varied flow in nonprismatic channels are described. For solution an arbitrary formula of velocity can be used. (Knapp-USGS)
W70-05531

8C. Hydraulic Machinery

DYNAMIC RESPONSE OF GUYED TOWERS TO WIND LOADING,
Bell Telephone Labs., Inc., Whippany, N.J.
K. I. Beitin.
Prepr 1032, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 30 p, 5 fig, 3 tab, 13 ref, append.

Descriptors: *Guyed towers, Gusts, *Wind pressure, Towers, *Structural behavior, Structural design, Structural models, Vibrations, Transmission towers, *Statistical methods, Natural frequency, Resonance, Flexibility, Damping, Deflection, Energy absorption, Bending, Cables.
Identifiers: Dynamic loads, *Dynamic response, Flexible structures, Vibration control, Matrix methods (Structural), Aeolian vibration.

Because of the random nature of wind action, the dynamic response of structures can be treated better statistically. A method based on the statistical theory of stationary random processes was developed to determine the dynamic response of guyed towers to gusty winds. The response of the multi-degree-of-freedom system for a given windstorm is dependent on the magnitude of resonant frequencies of vibration of the structure; the lower the frequencies the more effective is the coupling between oscillation and wind agitation. The method was applied to a 300-ft guyed tower. For this structure, the 3 sigma dynamic deflection (sigma being the standard deviation) may be as much as 1.9 times the mean deflection. This greater than expected response is attributed to the low frequencies of vibration of the guy cables and underscores the important role of cable vibration on tower motion. Improperly designed cables may produce low frequency oscillations that extract more energy from wind turbulence. The design techniques are conservative and should be used in place of the seemingly unreliable quasi-static methods. (USBR)
W70-05212

CAVITATION CHARACTERISTICS OF BALL AND BUTTERFLY VALVES,
Colorado State Univ., Fort Collins.
Raymond A. Hogan, and J. Paul Tullis.
Preprint 1056, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 39 p, 14 fig, 1 tab, 16 ref, append.

Descriptors: *Cavitation, *Butterfly valves, Hydraulic valves, Models, Prototypes, Experimental data, Instrumentation, Orifices, Performance, Discharge coefficients, Velocity, Laboratory tests, Reynolds number, Geometry, Hydraulics, Scale, Test procedures, Model tests, Hydraulic gates and valves, Bibliographies.
Identifiers: *Cavitation parameters, *Cavitation index, Test results, Cavitation noise, *Ball valves.

Application of valve cavitation data obtained experimentally is complicated by the existence of so-called scale effects. Designers are unable to apply cavitation data obtained from model tests to a prototype with confidence that the prototype will operate at or below the expected degree of cavitation. Scale effects are caused by the lack of a suitable cavitation parameter, accounting for all major factors influencing the cavitation process. Because of the unusually large number of major factors influencing cavitation and the necessity for reducing the number of variables to a tolerable level for analysis, scale effects exist. Size and pressure level scale effects related to cavitation in valves and to the application of generalized valve information are reviewed. The more popular cavitation parameters are discussed, and an attempt is made to find a more suitable cavitation parameter that would make these scale effects predictable. Information obtained from testing 3 sizes of geometrically similar, circular, concentric orifices, and results of several other investigations are included for comparison and evaluation of the proposed new cavitation parameter. (USBR)
W70-05213

SELECTION OF OUTLET WORKS GATES AND VALVES,
Warren H. Kohler.
Preprint 1057, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 30 p, 3 fig, 3 ref, append.

Descriptors: *Hydraulic gates and valves, Hydraulic gates, Hollow jet valves, Hydraulic valves, Safety, Reliability, Maintenance, Plug valves, Costs, Hydraulic design, Slide gates, *Outlet works, Sprays, Discharge (Water), Radial gates, Butterfly valves, Roller gates, Needle valves.
Identifiers: Selection, Jet-flow gates, Spherical valves.

Data and discussion outline factors involved in selecting gates or valves for outlet works. Complexity of the numerous types of gates and valves precludes detailed descriptions of the special features of each type. Only basic individual characteristics important from an overall selection standpoint are described. In selecting suitable outlet works gates or valves, the essential requirement is that all hydraulic needs are met. Usually more than one arrangement of gates or valves will meet basic hydraulic requirements. Other factors should be considered in the arrangement and selection of equipment for outlet works, including safety, reliability, general arrangement, operation conditions, maintenance, and costs. Selection always involves some compromises in providing an optimum solution, but safety, reliability, and sound hydraulics are not subject to compromise. (USBR)
W70-05214

SUB-SPAN GALLOPING EASED ON EHV LINE.

Elec World, Vol 172, No 24, p 34-37, Dec, 1969. 4 p, 7 fig, 2 tab.

Descriptors: Transmission lines, *Vibrations, *Failure (Mechanics), Extra high voltage, Fractures, *Fatigue (Mechanics), Conductors, Winds, *Bundled conductors, Dampers, *Oscillation, Instrumentation, Bending moments, Frequency, Field tests, Cracking, Stress.
Identifiers: Aeolian vibration, Galloping conductors, Outages, Electric conductors, *Transmission line hardware.

Lowering one subconductor in a horizontal bundle promises to ease sub-span galloping related to suspension hardware failures on twin-bundled 500-kv transmission lines. Unusual oscillations of conductors were observed during 40- to 50-mph winds approaching the line at near right angles over fairly level ground. Portland General Electric and Bonneville Power Administration engineers reached this conclusion after extensive investigations of suspension hardware failures on their lines within a year after installation. Vibration studies are discussed. (USBR)
W70-05227

EFFICIENCY IMPROVEMENT BY HIGH PRESSURE SHROUD AERATION OF TURBINES AND PUMPS ON A 75,000-HP TURBINE,
Dominion Engineering Works Ltd., Montreal (Quebec).
R. S. Sproule, and P. Koeller.
Amer Soc Mech Eng Publ 69-WA/FE-10, ASME Winter Annu Meet, Los Angeles, Calif, Nov, 1969. 8 p, 8 fig, 2 ref.

Descriptors: *Francis turbines, *Pump turbines, *Aeration, Cavitation, Hydraulic machinery, Compressed air, *Efficiencies, *High pressure, Test procedures, Automatic control, Instrumentation, Noise reduction, Turbine parts, Peaking capacities, Losses, Field tests, Flow, *Turbines, *Pumps, *Centrifugal pumps.
Identifiers: *Turbine efficiency, Test results, Foreign testing, Canada.

Shroud drag in a Francis turbine is a source of more than 1% efficiency loss. In a high head pump, shroud drag can consume 5% of the power input. Efficiency losses can be reduced by rotating the shrouds in air instead of in water. Many relative efficiency measurements were performed on a 75,000-hp Francis turbine at 900 ft head. High-pressure shroud aeration produced an efficiency increase as high as that calculated for shroud drag reduction. Above and below the best efficiency load, the injected air caused additional efficiency improvement, 50% more than the recoverable shroud drag losses. Aeration reduced the noise level, particularly at off-peak efficiency operation which Francis turbines tend to be noisy. Shroud aeration causes a decrease in turbine flow resulting in water saving for a longer peaking capability. Using aeration in a pump-turbine plant will produce approximately 1.5% more peaking energy with about 1.5% less energy input. (USBR)

W70-05229

OVERHEAD-LINE OSCILLATIONS AND THE EFFECT OF AERODYNAMIC DAMPERS,
Central Electricity Generating Board, Leatherhead (England).
J. C. R. Hunt, and D. J. W. Richards.
Proc Inst Elec Eng (Engl), Vol 116, No 11, p 1869-1874, Nov 1969. 6 p, 6 fig, 1 tab, 11 ref, 2 append.

Descriptors: *Transmission lines, *Dampers, Oscillation, *Winds, Wind velocity, Vibrations, Vibration suppressors, *Conductors, Wind tunnels, Bundled conductors, Ice, Testing, Energy, Energy dissipation, Foreign research.
Identifiers: *Aeolian vibration, *Galloping conductors, Aerodynamic forces, Wind direction, Amplitude, Great Britain.

An attempt is made to further the understanding of aerodynamic effects in large-scale vertical oscillations of overhead lines, usually referred to as galloping. The energy per cycle dissipated by the aerodynamic drag is calculated, and then, assuming that the lift coefficient of the cable is less than some measured maximum value, the maximum possible amplitude of oscillation is found for a given wind speed. The theory gives a plausible value of minimum wind speed at which clashing of conductors can occur, and a physical explanation for the given amplitude reached. The theory was used for estimating the effect of aerodynamic dampers in reducing the amplitude of galloping. Such dampers have been used in Canada, but the theory justifying the use appears inadequate. The method of calculation estimates the minimum effect such dampers can have. The performance of some cylindrical dampers proposed for use on twin lines where pairs of cables are suspended about 0.3 m apart is examined. (USBR)
W70-05238

GOPHER DAMAGE TO BURIED CABLE MATERIALS,
Bell Telephone Labs., Inc., Murray Hill, N.J.; and Bureau of Sport Fisheries and Wildlife, Denver, Colo.
For primary bibliographic entry see Field 08G.
W70-05240

8D. Soil Mechanics

EFFECTS OF VIBROFLOTATION ON CLAYEY SANDS,
Webb (Desmond L.) and Associates, Durban (South Africa).
Desmond L. Webb, and R. Ian Hall.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM6, p 1365-1378, Nov, 1969. 14 p, 11 fig, 1 tab, 13 ref, 3 append.

Descriptors: Alluvial deposits, Aeolian soils, Compaction, Compaction equipment, Compaction tests, Borings, Effects, Fines, Field tests, *Foundations, Loose soils, Penetration resistance, Penetration tests, Penetrometers, Settlement (Structural), *Soil compaction, Soil density, Soil mechanics, Saturated soils, Sands.
Identifiers: Vibratory compaction, *Vibroflotation, In situ tests, Foreign testing, South Africa.

Significant increases in density can be achieved in loose silty and clayey sands containing up to 30% clay by vibroflotation. Results are not as good as in clean sands, and vibroflotation might reduce the strength of clays or dense clayey sands in the subsoil. Field data are presented for 5 different saturated sandy materials from 3 sites. Satisfactory results were obtained using the static cone penetrometer for checking the effectiveness of vibroflotation during preliminary tests and for subsequent compaction control. When crushed stone fill (instead of sand) is added to the vibroflot crater, compaction of saturated clayey sands is improved, but the amount of compaction and the zone of influence of the vibroflot decrease with increasing clay content. The method of superimposing the effects of adjacent vibroflots, given by D'Appolonia, to predict compaction is valid for clayey sands. Using the average cone-penetration resistances to predict settlements after vibroflotation leads to overly conservative values. (USBR)
W70-05223

ROCKFILL DAMS AND ASPHALT CONCRETE.

Transl from German, Bur Reclam Transl 831, Dec, 1969. 16 p, 5 fig, 1 tab, 9 ref. Die Bautech, Vol 46, No 10, p 331-335, 1969.

Descriptors: Dam design, Dam construction, *Rockfill dams, *Asphaltic concrete, Dams, Waterproofing, Construction materials, Earth dams, Rock properties, Bituminous materials, Seepage, Construction, Slopes, Slope stability, Inspection, Maintenance.
Identifiers: *Dam facings, Dam stability, Construction methods, Design improvements, Design practices, Asphalt membranes, Construction control.

Using asphalt concrete in constructing rockfill dams and similar structures is regarded by many engineers as an established method. Asphalt concrete is a reliable, durable, machine-produced material enabling designers to use quality to replace sheer bulk. Two factors favoring the selection of rockfill dams are: (1) using an inexpensive source of rock, and (2) increasing cost of waterproofing processes involving manual labor compared to the refinement of asphalt concrete techniques. When core or filter materials are costly or in short supply and the major part of a dam will be pervious materials, elimination of the impervious fill and use of asphalt concrete for the water barrier is indicated because steeper slopes can be used, fill materials can be placed with less zoning and in almost any weather, and the dam can be raised easily at a later date. Developments affecting design of fill-type dams and problems of estimating costs of designs that have limited precedent are discussed. A partial list of dams having asphalt concrete water barriers is given. (USBR)
W70-05226

THE SETTLEMENT OF UNDER-REAMED AND STEP-TAPER PILES,
Sydney Univ. (Australia).
H. G. Poulos.
Inst Eng, Aust. Civ Eng Trans, Vol CE11, No 1, p 83-87, Apr 1969. 5 p, 10 fig, 2 tab, 12 ref.

Descriptors: *Settlement (Structural), *Piles (Foundations), Friction piles, Step-downs, Pile bearing capacities, Foundations, Elastic theory, Foreign research, *Theoretical analysis, Behavior, Pile foundations, Pile friction.
Identifiers: Comparative studies, Australia, Bored piles.

A theoretical analysis based on elastic theory was made of the settlement behavior of incompressible under-reamed and step-tapered piles within a semi-infinite mass. Under-reamed piles settle less than uniform piles of equal shaft diameter. The settlement reduction is determined primarily by the diameter of the enlarged bulbs and by the total effective length of the bulbs. Step-taper piles settle more than uniform piles of equal butt diameter. The increase in settlement is dependent only on the ratio of the tip-to-butt diameter. For a given pile volume and length, under-reamed piles settle less than uniform piles, and uniform piles settle less than step-taper piles. (USBR)
W70-05236

THE PORE PRESSURE-STRAIN RELATIONSHIP OF NORMALLY CONSOLIDATED UNDISTURBED CLAYS. PART I. THEORETICAL CONSIDERATIONS. PART II. EXPERIMENTAL INVESTIGATION AND PRACTICAL APPLICATIONS,
Laval Univ., Quebec.
K. Y. Lo.
Can Geotech J, Vol 6, No 4, p 383-412, Nov 1969. 30 p, 13 fig, 2 tab, 41 ref, 3 append.

Descriptors: *Pore pressure, Pore water pressures, *Strain, Saturated soils, Theory, Stress, Consolidation, Soil compression tests, Effective stress, Soil mechanics, Stress-strain curves, Experimental data, *Clays, Soil tests, Mathematical analysis Triaxial compression, Bibliographies.
Identifiers: *Undisturbed soils, Strain rate, Triaxial tests, Undrained tests.

A review of current theories of predicting pore pressures in saturated clays is presented. Mathematical analysis shows that the pore pressure induced by shear may be expressed as a sole function of major principal strain. This approach eliminates the anomalies inherent in the stress theories for pore pressure. Experimental results on normally consolidated undisturbed clays of various sensitivities are analyzed. The pore pressure ratio-strain relationship for isotropically and anisotropically consolidated samples is independent of the magnitude of consolidation pressures, time of sustained stress, time of consolidation, and intrinsic anisotropy under plane strain and axially symmetric stress conditions. Pore pressures set up under plane strain conditions can be estimated from results of triaxial tests. The effect of strain rate was small for the clays tested, and became insignificant at large strains. The relevance of findings to practical problems is discussed, and some problems especially suited to the pore pressure-strain approach are presented. (USBR)
W70-05246

SEISMIC WAVE VELOCITY AS A MEANS OF IN-PLACE DENSITY MEASUREMENT, FINAL REPORT - PART 1 OF 2,
Iowa State Univ., Ames.
J. M. Hoover, J. M. Hogan, and R. L. Handy.
Eng Res, Iowa State Univ, Ames, 1969. 38 p, 22 fig, 2 tab, 12 ref.

Descriptors: Seismic studies, Seismic waves, Field tests, Dry density, *Field density, Laboratory tests, Test procedures, Testing machines, Quality control, *Soil density, Soil engineering, Soil mechanics, Soil moisture, Soil tests, Theory, Correlation analysis, *Moisture content, Optimum moisture content.
Identifiers: *In place density, *Seismic velocity, *Seismic refraction, In place moisture, Seismic tests, In situ tests, Testing equipment.

Use of the seismic refraction technique to determine in-place dry density of embankment soils was investigated. Laboratory studies involved correlation of seismic wave measurements with conventional dry density and moisture content measurements of several soils. Field seismic measurements were correlated to in-place moistures and densities. Seismic velocity versus moisture content curves for standard and modified Proctor compacted laboratory soil specimens are similar in shape to dry density versus moisture content curves, but peak with about 1.2 plus or minus 0.9% lower moisture content, the plus or minus entry indicating one standard deviation on the mean. The seismic velocity versus moisture content curves are very sensitive to compaction wet of optimum and are not applicable when the moisture content greatly exceeds optimum. Field velocities obtained in this study were too low for a reliable estimation of field density. Subsequent tests indicated a gradual reduction in velocity upon aging, apparently because of absorption of pore water into the expandable interlayer region of the clay. Seismic tests should be conducted immediately after compaction or the results become meaningless. (USBR)
W70-05247

DESIGN OF STABLE OPEN CHANNELS USING CRITICAL TRACTIVE-FORCE CONCEPT,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-05298

8E. Rock Mechanics and Geology

DIFFICULT EXCAVATION AT CARLEY PORTER TUNNEL,
Dravo Corp., Gorman, Calif.
Paul J. Varello.
Preprint 1005, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 22 p, 8 fig.

Descriptors: *Tunnels, *Tunnel construction, Faults (Geology), Gunite, Groundwater flow, Tunneling machines, Shields, Grouting, Grout curtains, Chemical grouting, Chimneys, Sinkholes, Wellpoints, Tunnel failure, Core drilling, Earth handling equipment, Excavation, Methodology, Engineering geology, Tunnel linings.
Identifiers: Carley V Porter Tunl (Calif), Unstable ground, Squeezing pressures, *Running ground.

The Carley V Porter Tunnel, a part of the California Aqueduct, the main artery of the California State Water Project, is located 60 mi north of Los Angeles in the Tehachapi Mountain Range. The Porter Tunnel traverses a portion of the Tehachapi Range whose geology is dominated by the presence of the 2 largest fault systems in California: the San Andreas and Garlock. The tunnel is 25,075 ft long, has a driven diameter of 24 ft, and a finished diameter of 20 ft. The width of the faults varies from a few inches to hundreds of feet and much groundwater was generally present with the wider zones. Advanced from 2 headings, the tunnel was driven by a tunneling shield with a fabricated steel liner plate support system. Advances were made by jacking against the liner plate supports. Conventional drilling and shooting techniques were used. Because of unusually difficult tunneling conditions, the excavation will be about 16 mo behind schedule. Approximately 90% of the down time was the result of severe running and caving ground conditions, complicated by heavy groundwater flow into the tunnel. Difficulties in driving the tunnel and methods used in overcoming them are described. (USBR)
W70-05209

STRESS CONCENTRATION FACTORS FOR THE FLAT BOREHOLE END FOR USE IN ROCK STRESS MEASUREMENTS,
National Mechanical Engineering Research Inst., Pretoria (South Africa).
W. L. Van Heerden.
Eng Geol Int J, Vol 3, No 4, p 307-323, Oct, 1969. 17 p, 6 fig, 4 tab, 11 ref.

Descriptors: Stress, Stress analysis, Stress concentration, *Strain measurement, *Stress distribution, Strain, Stress relieving, *Boreholes, Strain gages, *Rock mechanics, Rocks, Poisson ratio, Rock properties, Photoelasticity, Models.
Identifiers: *Overcoring method, Borehole deformation gage, Foreign testing, Photoelastic stressmeters, South Africa, Rock tests.

Stress cannot be measured directly but can be determined only from measurements of its effects, notably deformation or strain. To determine the absolute stress in rock, strain relief measurements are often performed by overcoring a borehole containing electrical resistance strain gages or a photoelastic disc at the flattened end. If the elastic moduli of the rock are known, the stresses on the flat end of the borehole can be calculated; before the rock stress can be determined, the stress concentration around the flat end of the borehole in terms of stress concentration factors must be known. A photoelastic model study and uniaxial loading tests of different materials are described. From these tests, the stress concentration factors are determined for the flat end of a borehole drilled into the materials and in the model. Results show that one of the stress concentration factors is related to Poisson's ratio. (USBR)
W70-05216

EARTHQUAKE PREDICTION AND CONTROL,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07B.
W70-05218

THE COMPRESSIVE STRENGTH OF HARD ROCK,
National Mechanical Engineering Research Inst., Pretoria (South Africa).
Z. T. Bieniawski.
Tydskr Natuurwetensk, Vol 8, No 3/4, p. 163-182, Sept/Dec 1968. 20 p, 11 fig, 3 tab, 9 ref, 2 append.

Descriptors: *Compressive strength, Rocks, *Rock mechanics, Samples, Engineering geology, *Shape, *Rock properties, Laboratory tests, *Size, Quartzite, Sandstones, Experimental data, Cracking.
Identifiers: Uniaxial compression, Rock tests, South Africa, Foreign testing, Test results, In situ tests.

Knowledge of rock properties is essential if the behavior of the rock surrounding mining excavations is to be understood. Rockbursts, roof falls, stope closure, and scaling of working faces are influenced directly by the properties of the peripheral rock. Safe and economic design of mining excavation can be achieved only if reliable information is available on the strength characteristics of the rock. Because of predominance of compressive stresses in mining problems, determination of the compressive strength of rock is particularly important. The compressive strength of rock is not determined easily. Rock is not a perfectly homogeneous isotropic solid, but contains many discontinuities such as cracks, pores, and cleavage planes, directly influencing the properties of the material. Uniaxial compression tests show a reduction of 25% in strength for 5-in. cube and EX core specimens; constant strength for cube specimens larger than 5 in.; the same strengths for cylindrical, cubic, or prism specimens of equal volumes; and no affect on strength of specimens within the 0.33 to 2.00 width-height ratios and 1.0 to 3.8 length-width ratios. Practical implications are discussed. Laboratory strength data on hard rock offer realistic information for solving practical mining problems in hard rock. (USBR)
W70-05250

STABILITY OF TUNNELS UNDER ROCK LOAD,
L. V. Rabcewict.
Water Power, Vol 21, No 6, 7, 8, p. 225-229, 266-273, 297-302, June, July, Aug, 1969. 19 p, 41 fig, 22 ref.

Descriptors: *Tunnel construction, Tunnel failure, Tunnel design, Rock mechanics, *Tunneling, *Tunnel linings, Theory, Shear failures, Anchors, Theoretical analysis, Shear stress, Structural behavior, Bibliographies, Model tests, Flexible linings, Gunite, Tunnels, Deformation, Structural design, Stability, Foreign design practices.
Identifiers: *Austrian Tunneling Method, *Tunnel supports, Yielding, Austria, Concrete linings, Rock pressures, Stress relaxation.

The salient feature of the New Austrian Tunneling Method is a semirigid lining applied to the rock before it is damaged by loosening. The lining, designed to reach permanent equilibrium after adjusting to rearrangement forces, may be any material or combinations of materials suited to the purpose. Tunnels should be driven full face where possible in a minimum of time. Practical experience and theoretical investigations have proved that by using the method, rock surrounding a cavity can be transformed into an effective carrying member. Failure by shear is the only mode of collapse of a tunnel lining when the lining extends around the entire periphery of the tunnel section. Principles for designing linings based on failure by shear are explained and proved by model tests. Some theoretical analyses of the strength of linings and anchors are presented and a design method based on data collected on shear failure is discussed. The effect of contact between lining and rock on tunnel behavior is examined. A type of strengthening consisting of system anchoring combined with shotcrete, taking advantage of the property of rock to stabilize by yielding, is described. A tunnel and an underground powerhouse constructed in accordance with the New Austrian Tunneling Method are described. (USBR)
W70-05252

8F. Concrete

CONSTRUCTION PROCEDURES FOR LARGE-SCALE CONCRETE STRUCTURES FOR OCEAN ENGINEERING,
Santa Fe Poeroy, Inc.
Ben C. Gerwick, Jr.
Preprint 1053, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 29 p.

Descriptors: Construction, Submergence, *Underwater construction, *Marine engineering, Oceans, Concrete construction, Concrete technology, Concrete control, *Concrete structures, Prestressed concrete, Planning, Floating, Fabrication, Installation, Quality control, Underwater, Structures.
Identifiers: Construction control, *Construction methods, Construction practices, Concrete properties, Floating structures.

Concrete is the ideal material for large-scale floating and submerged ocean structures. Methods of launching, fabricating, assembling, and installing concrete structures for ocean use are described. Launching methods include: (1) sliding structures into the water on launching ways, (2) tidal floating, (3) drydock flooding, (4) basin flooding, (5) lowering from platforms, (6) barge flooding, (7) excavation of natural or artificial islands from beneath structures (sandjack method), (8) rolling into water, (9) collapsing platforms, and (10) construction afloat. Using concrete for ocean structures imposes stringent demands on quality, requiring the most advanced concrete technology and strict construction control. Advantages of prestressing are summarized and potentials of ferro-cement techniques and lightweight concrete are discussed. Methods of installation and sinking include: (1) casting-in-place, (2) bottom assembly, (3) assembly afloat, (4) prejoining sections, (5) external buoyancy tanks, (6) submerged lowering, (7) pull down, (8) buoyancy control by air or pressure, and (9) flooding. (USBR)
W70-05210

ROCKFILL DAMS AND ASPHALT CONCRETE.
For primary bibliographic entry see Field 08D.
W70-05226

PREPLACED AGGREGATE CONCRETE FOR STRUCTURAL AND MASS CONCRETE,
American Concrete Inst., Detroit, Mich.
Donald L. Houghton, Albert B. Crosby, and Howard E. Willey.
Amer Concr Inst J Proc, Vol 66, No 10, p 785-797, Oct, 1969. 13 p, 4 fig, 2 tab, 12 ref.

Descriptors: Concretes, *Concrete placing, *Concrete technology, Mass concrete, Concrete construction, Concrete control, Concrete finishing, Concrete mixes, Standards, Grouting, Portland cements, Aggregates, Coarse aggregates, Quality control, Curing, Injection, Underwater construction.
Identifiers: Structural concrete, Concrete properties, *Prepacked concrete, Grout mixes.

Preplaced aggregate concrete is formed by filling the forms with clean well-graded aggregate and injecting grout into the voids of the aggregate mass. This method of placing concrete is adaptable to underwater construction, concrete and masonry repairs, and new structures where placement by conventional methods is difficult or where concrete

of low volume change is required. Preplaced aggregate concrete contains more coarse aggregate than conventional concrete, resulting in less drying shrinkage and a slightly higher modulus of elasticity. Cements, admixtures, pozzolans, aggregates, and grout mix proportioning are discussed. Concrete forms, coarse aggregate placement, grout pipe systems, mixing and injection, finishing, curing, and quality control methods are described. ASTM and Corps of Engineers Standards are listed. (USBR)
W70-05228

CHEMICALLY PRESTRESSED CONCRETE,
Samuel Aroni, Vitelmo Bertero, and Milos Polivka.
J Prestressed Concr Inst, Vol 13, No 5, p 22-35, Oct, 1968. 14 p, 4 fig, 21 ref.

Descriptors: *Portland cements, Prestressing, Precast concrete, Concrete structures, *Prestressed concrete, *Concretes, Concrete mixes, *Concrete technology, Durability, Workability, Concrete pipes, Composite structures, Beams (Structural), Shell structures, Bibliographies.
Identifiers: Cement chemistry, *Expanding cements, Concrete slabs, Calcium sulfoaluminate, *Chemical prestressing.

The peculiar features of self-stressing expansive cement concrete are presented, and structural problems and special techniques with chemical prestressing are reviewed. The report is based upon experiences with Type K cement produced at the Engineering Materials Laboratory of the University of California at Berkeley, but the results may be qualitatively applied to other types of expansive cements. Type K cement is a mixture of portland cement (low in tricalcium aluminate), with anhydrous calcium sulfoaluminate as the expansive component. Composition of the cement, nature of expansion, creep, shrinkage, curing, restraint, and workability are discussed. Chemically prestressed concrete appears promising for use in large prefabricated structural units, composite elements, and prefabricated elements requiring low optimum prestress such as pipes, columns, and surface elements. Materials and structural problems needing additional research are listed. (USBR)
W70-05230

8G. Materials

GOPHER DAMAGE TO BURIED CABLE MATERIALS,
Bell Telephone Labs., Inc., Murray Hill, N.J.; and Bureau of Sport Fisheries and Wildlife, Denver, Colo.
R. A. Connolly, and R. E. Landstrom.
Mater Res Stand, Vol 9, No 12, p 13-16, 43, 46, Dec 1969. 6 p, 7 fig, 4 tab, 11 ref.

Descriptors: *Electric cables, *Damages, *Gophers, Rodents, Copper, Rodenticides, Communication, Corrosion, Animal behavior, Epoxy resins, Lead (Element), Asbestos, Asphalt, Polyethylenes, Vinyl plastics, Glass fibers, Rubber, Test procedures.
Identifiers: *Buried cables, Underground cables, Corrosion resistant alloys, Test results.

The pocket gopher has long been known to damage buried wire and cable. Laboratory tests with the plains pocket gopher were conducted to determine the resistance of various materials and wire and cable configurations of gopher attack. Of the organic materials tested, only epoxy-fiber glass offered protection against these animals. All sheet metals in thicknesses of 0.005 to 0.010 in. (except aluminum and lead) offered complete protection. The size and core construction of the wire and cable influenced damage. The results are in line with field experience. Test procedures are described and results evaluated. The degree of damage to unarmored wire and cable is inversely proportional to the diameter. Armored cables offer gopher protection to the cable cores, but once the armor is exposed, the corrosion resistance of the armor becomes important. Contrary to accepted beliefs, cables in field services may experience gopher attacks causing significant damage as long as 6 yr after installation. (USBR)
W70-05240

8I. Fisheries Engineering

SIMPLE STREAM TANK SIMULATING A RAPIDS ENVIRONMENT,
Manitoba Univ., Winnipeg. Dept. of Zoology.
For primary bibliographic entry see Field 07B.
W70-05096

FISHERIES AND GAME: STATE BOARD.
For primary bibliographic entry see Field 06E.
W70-05447

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

INVENTORY OF WATER RESOURCES RESEARCH CONDUCTED IN MINNESOTA, 1963 THROUGH 1968.
Minnesota Univ., Minneapolis. Water Resources Research Center.

Available from the Clearinghouse as PB-190 440, $3.00 in paper copy, $0.65 in microfiche. Minnesota University Water Resources Research Center Bulletin 12, August 1969. 57 p, 9 fig, 6 tab, 2 append. OWRR Proj No A-999-MINN.

Descriptors: *Research and development, *Water resources development, *Minnesota, *Research facilities, Laboratories, Projects, Research equipment, Contracts, Allotments, Grants, On-site investigations, Planning, Technology, Bibliographies, Reviews.
Identifiers: Water resources research.

An inventory of water resources research conducted in Minnesota during the 6-year period 1963-68 is presented. The information concerning number and kinds of research, and man-years of research effort should: (1) provide a better understanding of past research activities of the University of Minnesota, State and private Colleges, and Federal, State, local and private organizations in Minnesota; (2) provide a better understanding of the role of the Water Resources Research Center in the total research effort in Minnesota; and (3) assist research administrators and funding agencies in making future allocations of manpower and funds for research efforts. (Knapp-USGS)
W70-05114

9D. Grants, Contracts, and Research Act Allotments

INVENTORY OF WATER RESOURCES RESEARCH CONDUCTED IN MINNESOTA, 1963 THROUGH 1968.
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 09A.
W70-05114

STORM AND COMBINED SEWER DEMONSTRATION PROJECTS, JANUARY 1970,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
For primary bibliographic entry see Field 05G.
W70-05467

10. SCIENTIFIC AND TECHNICAL INFORMATION

PROGRESS IN DEVELOPING AN INFORMATION SYSTEM TO DISSEMINATE CURRENT WATER RESOURCE SCIENTIFIC INFORMATION,
Water Resources Scientific Information Center, Washington, D.C.
Raymond A. Jensen, and Logan O. Cowgill.
Available from the Clearinghouse as PB-189 488, $3.00 in paper copy, $0.65 in microfiche. Proceedings of 13th Annual Conference on Water for Texas, Nov 25-26, 1968, Texas A and M University, College Station, p 24-28, 1968, 5 p. OWRR Project A-999-TEX.

Descriptors: *Documentation, *Abstracts, *Bibliographies, *Hydrology, *Water resources, Hydraulics, Groundwater, Surface waters, Technical writing, Reviews, Surveys, Information retrieval, Data collections, Data storage and retrieval, Hydrologic data, Publications.
Identifiers: *Water Resources Scientific Information Center, U. S. Department of the Interior.

The purpose, functions, origin, and history of the Water Resources Scientific Information Center, U.S. Dept. of the Interior, are reviewed. WRSIC's responsibility is to serve as a center for national water resources information, initiate activities to fill gaps in current information services, and make support agreements with water resources agencies. The national information system should include selection of literature by specialist organizations, dissemination services, and liaison with other national information systems. Service agreements have been negotiated with Federal agencies, Water Resources Research Institutes, Federal Basin Commissions, and other organizations. Center of competence agreements have been negotiated for special subject areas. Selected Water Resources Abstracts is the processed output of the centers of competence and the water resources agencies, and is produced for WRSIC by the Clearinghouse for Federal Scientific and Technical Information. Each issue has indexed abstracts as well as author, subject, organizational, and accession number indexes. An annual accumulative index appears at the end of the year. Services not derived from the information base include the Water Resources Research Catalog, selected bibliographical publications (such as a Permuted Title Index to Water Resources Journals for the Year 1967), and program development and evaluation studies. WRSIC is studying and identifying other primary and secondary information sources, particularly periodic journals in sociology, economics, and law, as well as other major abstracting services. (See Vol 2, No 16, Field 6B, W69-06790). (Knapp-USGS)
W70-05458

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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Office of Water Resources Research
U.S. Department of the Interior
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Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE
Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION
Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL
Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION
Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

COMPARATIVE WATERSHED STUDIES IN SOUTHERN SASKATCHEWAN,
Department of Agriculture, Swift Current (Saskatchewan). Experimental Farm.
W. Nicholaichuk.
American Society of Agricultural Engineers, Transactions, Vol 10, No 4, p 502-504, July-August 1967. 3 fig, 2 tab, 10 ref.

Descriptors: *Demonstration watersheds, *Watersheds (Basins), Runoff, *Precipitation (Atmospheric), *Semiarid climates, Chinook, Drainage, Small watersheds, Snow, Snowmelt, Soil moisture, Rainfall, Measurement, Meteorological data.
Identifiers: *Saskatchewan (Canada).

The comparative study of two semiarid watersheds in Saskatchewan was designed to ascertain differences in quantitative data expressed on a unit basis. Such data included precipitation and runoff volume in acre-inches. The results showed that runoff volumes measured in acre-inches per acre are generally higher for the larger watershed. This might be due in part to the Chinook winds which prevail in the region of the small watershed. Volumes may also differ when compared on a yearly basis even though amount of precipitation is almost equal. The study also indicates that 85% of watershed runoff in southern Saskatchewan is derived from snowmelt. The frequency in which runoff volumes from each watershed are equal was found to be 1.4 years. (Carr-Arizona)
W70-05595

SNOWMELT RUNOFF FROM MEASUREMENTS OF TRITIUM AND OXYGEN-18,
International Atomic Energy Agency, Vienna (Austria); Hydraulic Research Inst., Prague (Czechoslovakia); and Pisa Univ. (Italy). Inst. of Nuclear Geology.
For primary bibliographic entry see Field 02C.
W70-05673

A STOCHASTIC MODEL OF LONGITUDINAL DIFFUSION IN POROUS MEDIA,
Colorado State Univ., Fort Collins.
P. Todorovic.
Water Resources Research, Vol 6, No 1, p 211-222, February 1970. 12 p, 11 fig, 2 tab, 3 ref. NSF Grant GK-11499.

Descriptors: *Statistical models, *Diffusion, *Stochastic processes, *Groundwater movement, *Porous media, Model studies, Mathematical models, Statistical methods, Diffusivity, Hydraulic models, Dispersion, Tracking techniques, Tagging, Tracers.
Identifiers: Longitudinal dispersion.

A set of tagged particles carried along by a fluid flow through a porous media is subject to random dispersion. The total distance from the origin, in the direction of the main flow traveled by a tagged particle, is a stochastic process. To use Lagrangian description of the dispersion, the distribution function of the traveled distance for every time must be determined. This distribution is not Gaussian and depends on two parameters which in turn depend on hydraulic conditions. To apply Eulerian description, the distribution function of time a tagged particle to travel a given distance x is derived. This distribution is not Gaussian either, and depends on the same two parameters. The sum of these two distributions is always one. This identity represents the relationship between Lagrangian and Eulerian descriptions. According to experimental results, the theoretical distributions agree reasonably well with observed distributions. (Knapp-USGS)
W70-05683

URBAN STORM RUNOFF RELATIONS,
Nebraska Univ., Lincoln; Public Health Service, Denver, Colo.; and Maine Univ., Orono.
For primary bibliographic entry see Field 04C.
W70-05684

A METHOD OF DERIVATION OF NONCONSTANT WATERSHED RESPONSE FUNCTIONS,
Agricultural Research Service, Athens, Ga. Southeast Watershed Research Center.
W. M. Snyder, W. C. Mills, and J. C. Stephens.
Water Resources Research, Vol 6, No 1, p 261-274, February 1970. 14 p, 8 fig, 4 tab, 11 ref.

Descriptors: *Hydrograph analysis, *Depth-area-duration analysis, *Rainfall-runoff relationships, Mathematical studies, Mathematical models, Unit hydrographs, Computer programs, Demonstration watersheds, Optimization, Synthetic hydrology, Systems analysis, Runoff forecasting, Streamflow forecasting.
Identifiers: Hydrograph synthesis, Watershed models.

A practical numerical method has been developed for storm hydrograph analysis that allows variation of unit response functions during multiple periods of runoff producing rainfall. Previous methods of analytical derivation of unit responses from multiple period storms require superpositional linearity. This requirement is eliminated by substituting two stages of convolution for the conventional single-stage process of storm hydrograph generation. The first stage convolves a fixed area-characteristic function with a variable state function. The state function is determined by streamflow and differs for each increment of effective rainfall. First stage convolution thus produces a different unit response for each increment. The second stage convolves the variable unit responses and the effective rain increments. Validity of the technique is demonstrated by applying the analytical model to 10 complex storms. The conceptual components of area-characteristic, area-state, and variable response functions resulting from the analyses are seen to be hydrologically rational. (Knapp-USGS)
W70-05685

A GRAPHIC PRESENTATION OF STREAM GAIN OR LOSS AS AN AID IN UNDERSTANDING STREAMFLOW CHARACTERISTICS,
Geological Survey, Huron, S. Dak.
For primary bibliographic entry see Field 02E.
W70-05687

STREAM TEMPERATURE PREDICTION MODEL,
Bonneville Power Administration, Portland, Oreg.
William L. Morse.
Water Resources Research, Vol 6, No 1, p 290-302, February 1970. 13 p, 5 fig, 3 tab, 27 ref.

Descriptors: *Water temperature, *Forecasting, *Mathematical models, Thermal pollution, Reservoirs, Meteorology, Heat transfer, Mass transfer, Convection, Radiation, Conduction, Heat budget, Columbia River.
Identifiers: Water temperature forecasting.

Given certain meteorologic and hydraulic-hydrologic data, a dynamic deterministic one-dimensional model, based on evaluation of the heat exchange across the air-water interface, predicts the water temperatures of streams. The model itself is a quasilinear partial differential equation that represents an abbreviated energy conservation equation. For an extended upper reach (200 miles) of the Columbia River during July 1966, it has predicted water temperatures on the average within 0.3 deg F. More important, this model has been subjected to a statistical validity test which indicates a certain level of acceptance. (Knapp-USGS)
W70-05690

ATMOSPHERIC WATER BALANCE AND HYDROLOGY OF THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02B.
W70-05691

LENGTH OF STREAM FOR AN INDEPENDENT EVENTS MODEL,
Northwestern Univ., Evanston, Illinois.
Michael F. Dacey.
Water Resources Research, Vol 6, No 1, p 341-344, February 1970. 4 p, 4 ref. NSF Grant GS-1627.

Descriptors: *Drainage patterns (Geologic), *Tributaries, Drainage density, Statistical methods, Mathematical studies, Geomorphology, Watersheds (Basins), Channel morphology, Streams, Erosion.
Identifiers: *Stream length, Stream order.

An independent events model is formulated for stream length. The stream is composed of links, where the number of links has the geometric distribution and link lengths are independently and identically distributed as the gamma variate with shape parameter a. This model is similar in all essential respects to the topologically random stream structure formulated by Shreve. This paper extends his results and shows that for $a = 2$ the distribution of stream length obeys a probability law defined by the modified Bessel function. It is also shown that when the expected number of links in a stream is large, stream length is approximated by the exponential distribution. (Knapp-USGS)
W70-05696

WEEKLY AND NONTHLY FLOWS IN SYNTHETIC HYDROLOGY,
North Carolina Univ., Chapel Hill; and Florida Univ., Gainesville.
David H. Moreau, and Edwin E. Pyatt.
Water Resources Research, Vol 6, No 1, p 53-61, February 1970. 9 p, 6 fig, 2 tab, 11 ref.

Descriptors: *Synthetic hydrology, *Streamflow forecasting, North Carolina, Markov processes, Statistical models, Simulation analysis, Mathematical models, Systems analysis, Digital computers, Hydrograph analysis, Statistical methods.
Identifiers: Monthly flow moments, Synthetic hydrographs.

A nonstationary model for synthesizing weekly flow patterns, such that means, variances, and covariances of weekly and monthly flows, as estimated from historical records, will be preserved under the assumption of a Markov structure for monthly flows, is developed and applied to the Haw River in North Carolina. Analyses show excellent agreement between statistics of the historical record and those of the simulated record when weekly flows were assumed to follow a log normal distribution. A moving average process is used to reduce sampling errors of parameter estimates from the historical record. (Knapp-USGS)
W70-05698

ROUTE OR CONVOLUTE,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
D. E. Overton.
Water Resources Research, Vol 6, No 1, p 43-52, February 1970. 10 p, 8 fig, 19 ref.

Descriptors: *Unit hydrographs, *Routing, *Streamflow forecasting, *Hydrograph analysis, *Mathematical models, Synthetic hydrology, Simulation analysis, Optimization, Digital computers, Computer programs, Data processing, Model studies, Linear programming, Rainfall-runoff relationships.
Identifiers: Synthetic hydrographs.

Some of the conceptual hydrograph models for routing rainfall excess through a cascade of linear reservoirs have been reexamined. Because of the linearity of these models, convolution of the instantaneous unit hydrograph (IUH) is mathematically identical to synthetic hydrographs obtained by direct routing. Routing, however, has been a more traditional procedure mainly because the mathematics is much simpler and the solution of synthetic hydrographs is more direct. Also, reduction of storm duration in the IUH approach has significant disadvantages. If one chooses a linear cascade model for hydrograph synthesis, direct routing in the traditional sense is more direct, more informative, less tedious, and much less time consuming, and it permits sensitivity analysis of the model parameters as computational trials progress and accomplishes convolution implicitly. (Knapp-USGS)
W70-05702

ON THE THEORY OF EVOLUTION OF RIVER NETS,
Geological Survey, Urbana, Ill.
A. E. Scheidegger.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 109-114, March 1970. 6 p, 1 fig, 2 tab, 10 ref.

Descriptors: *Drainage patterns (Geologic), *Rivers, *Geomorphology, *Statistical models, Model studies, Statistical methods, Streams, Topography, Networks, Watersheds (Basins).
Identifiers: Random graph models, Topology, Stream order.

An investigation is made of the growth of river basins based on the two current models of the structure of such basins: the cyclic model and the random-graph model. Based on the assumption that the networks grow allometrically, the structure of the network that evolves has been calculated based upon the above two models. Nature seems to favor the random-graph model. (Knapp-USGS)
W70-05879

APPLICATIONS OF CROSSING THEORY IN HYDROLOGY,
Technical Univ. of Denmark, Copenhagen. Hydraulic Lab.
For primary bibliographic entry see Field 02E.
W70-05897

RUNOFF FORECASTING BY VARIABLE TRANSFORMATION,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
Mikio Hino.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7203, p 871-878, April 1970. 8 p, 10 fig, 7 ref, append.

Descriptors: *Runoff forecasting, *Rainfall-runoff relationships, Statistical methods, Statistical models, Streamflow forecasting, Runoff, Precipitation (Atmospheric), Frequency analysis.
Identifiers: Spectral analysis.

The linear prediction theory is extended to nonlinear rainfall-runoff systems by a single modification. Variables of rainfall and runoff are transformed by nonlinear functions into a domain where the coherence of rainfall and runoff is considerably increased. The runoff prediction is made in the transformation domain. The inverse transform yields improved runoff. Examples are shown to illustrate that the method is remarkably effective. (Knapp-USGS)
W70-05906

2B. Precipitation

METEOROLOGICAL DROUGHT IN IDAHO AS EXPRESSED BY THE PALMER INDEX,
Weather Bureau, Salt Lake City, Utah. Western Region.
Marvin D. Magnuson.
27 p., typewritten, (1967).

Descriptors: *Droughts, *Arid lands, *Moisture deficit, *Precipitation (Atmospheric), *Idaho, Climatic data, Weather data, Climatology, Rain, Meteorological data.
Identifiers: *Palmer index, *Drought severity, Index values, Meteorological drought.

Drought as a strictly meteorological phenomenon is defined as prolonged, abnormal moisture deficiency. An index has been developed by Palmer which treats drought severity as a function of weighted differences between actual precipitation and precipitation requirements. The method is employed here to provide a drought index for ten climatic regions of the state of Idaho for the years 1931-66. Each drought period is summarized by date of occurrence, duration, maximum severity, and number of months in each index class. This information is combined for each region to give the percentage of total months that were studied which fall within the definition of drought. The summaries reveal that the southwestern valley region of Idaho suffered the greatest percentage of drought months (44%), but that severe and extreme drought were more prevalent in the southwestern highlands. (Carr-Arizona)
W70-05601

METEOROLOGICAL DROUGHT IN MONTANA AS EXPRESSED BY THE PALMER INDEX,
Weather Bureau, Salt Lake City, Utah. Western Region.
Marvin D. Magnuson.
21 p., typewritten, (1967).

Descriptors: *Droughts, *Arid lands, *Moisture deficit, *Precipitation (Atmospheric), *Montana, Climatic data, Weather data, Climatology, Rain, Meteorological data.
Identifiers: *Palmer index, *Drought severity, Index values, Meteorological drought.

Drought as a strictly meteorological phenomenon is defined as prolonged, abnormal moisture deficiency. An index has been developed by Palmer which treats drought severity as a function of weighted differences between actual precipitation and precipitation requirements. The method is employed here to provide a drought index for seven climatic regions of the state of Montana for the years 1931-66. Each drought period is summarized by date of occurrence, duration, maximum severity, and number of months in each index class. This information is combined for each region to give the percentage of total months that were studied which fall within the definition of drought. The summaries reveal that the southeastern region of Montana suffered the greatest percentage of drought months (41%), but that severe and extreme drought were more prevalent in the western region. (Carr-Arizona)
W70-05602

TRITIUM RAINOUT IN THE UNITED STATES DURING 1966, 1967, AND 1968,
Massachusetts Univ., Amherst; and Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 05B.
W70-05670

SPATIAL DISTRIBUTION OF RAINFALL RATES,
Illinois State Water Survey, Urbana.
F. A. Huff.
Water Resources Research, Vol 6, No 1, p 254-260, February 1970. 7 p, 4 fig, 3 tab, 6 ref. Contract INT 14-06-D-6575. Contract DA-36-039-SC-64723.

Descriptors: *Rainfall disposition, *Rainfall intensity, *Distribution patterns, *Rain gages, *Network design, Remote sensing, Radar, Sampling, Meteorology, Isohyetes, Storms, Thunderstorms, Illinois.
Identifiers: Rain gage networks.

A 29-storm sample of 1-minute rainfall rates was obtained with an Illinois network of 50 recording gages in 100 square miles during the warm seasons of 1952 and 1953. These gages were equipped with enlarged orifices and 6-hour charts to provide nearly instantaneous spatial patterns of rainfall intensity on the network. The data were used to determine quantitative estimates of rainfall rate gradients, sampling errors in the measurement of mean areal rates, and spatial correlation patterns. The derived relations are considered first approximations for midwestern warm-season storms. It was concluded that the spatial variability of rainfall rates is frequently so great within and between convective storms that the rain gaging equipment and operational requirements for accurate rate measurements may be prohibitive for most users when sampling areas are 100 sq mi or greater. Consequently it is recommended that the use of radar in combination with recording gages be investigated as a possible solution to the measurement problem. (Knapp-USGS)
W70-05686

ATMOSPHERIC WATER BALANCE AND HYDROLOGY OF THE UPPER COLORADO RIVER BASIN,
Colorado State Univ., Fort Collins.
James L. Rasmussen.
Water Resources Research, Vol 6, No 1, p 62-76, February 1970. 15 p, 15 fig, 7 tab, 21 ref.

Descriptors: Climatology, *Rainfall-runoff relationships, *Colorado River basin, *Water balance, Hydrology, Discharge (Water), Colorado River, Precipitation (Atmospheric), Evaporation, Hydrologic budget, Hydrologic cycle, Rain gages, Precipitation gages, Networks, Topography, Synoptic analysis.
Identifiers: Atmospheric water balance.

The atmospheric water balance over the upper Colorado River is evaluated twice daily for the 7 winter seasons 1957-1963. The atmospheric water balance yields the exchange of water and water vapor at the earth-atmosphere interface through the observation of the spatial and time distributions and fluxes of water vapor in the atmosphere over the basin. The quantity precipitation minus evaporation is determined as a residual of the computation and is accumulated for daily and seasonal values. In addition, a natural period analysis is performed; the natural periods are delineated by homogeneity in the parameter precipitation minus evaporation. The dry periods are shown to exhibit a seasonal trend in evaporation rate as well as decay of evaporation rate with time within periods. Duration is shown to be the dominant factor in storm yield and the occurrence of a few large storms delineates the relatively wet from the relatively dry winters. Finally, the wintertime accumulation of water over the basin and the resulting annual runoff are shown to be highly correlated. (Knapp-USGS)
W70-05691

THE FREQUENCY AND INTENSITY OF WET AND DRY SEASONS AND THEIR INTERRELATIONSHIPS,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
David M. Hershfield.
Water Resources Bulletin, Vol 6, No 1, p 87-93, January-February 1970. 7 p, 3 fig, 4 tab, 6 ref.

Descriptors: *Probability, *Weather forecasting, *Statistical models, Markov processes, Droughts, Weather patterns.
Identifiers: Rainy day sequences, Dry day sequences.

The probabilities of wet- and dry-day sequences of various lengths were determined for several intensities. Dry-and wet-day sequences were studied from actual records of daily precipitation from 35 stations, most of which are east of Denver, for the purpose of describing their statistical distribution. The

geometric destribution is shown to represent the variation in the length of wet-day sequences. The results are identical to those derived from a simple Markov chain model. A relationship is presented which can be used with published data to obtain the one parameter required for the geometric distribution. The average relationship between this one parameter for both the wet and dry sequences is presented. In general, the larger the number of rainy days, the less variability in the annual rainfall totals from year to year and the larger the number of dry (or wet) sequences. Examples are presented which show the probabilities of occurrence associated with recent dry periods in Minnesota and the Washington, D.C., area. (Knapp-USGS)
W70-05704

RAIN GAGE SPACING AND REPORTED RAINFALL,
Universidad Central de Venezuela, Caracas; and Texas A and M Univ., College Station.
For primary bibliographic entry see Field 07A.
W70-05878

PHYSICAL VIEW OF CLOUD SEEDING,
Department of Commerce, Washington, D.C.; and Federal Council for Science and Technology, Washington, D.C.
For primary bibliographic entry see Field 03B.
W70-05893

2C. Snow, Ice, and Frost

SNOWMELT RUNOFF FROM MEASUREMENTS OF TRITIUM AND OXYGEN-18,
International Atomic Energy Agency, Vienna (Austria); Hydraulic Research Inst., Prague (Czechoslovakia); and Pisa Univ. (Italy). Inst. of Nuclear Geology.
T. Dincer, B. R. Payne, T. Florkowski, J. Martinec, and E. Tongiorgi.
Water Resources Research, Vol 6, No 1, p 110-124, February 1970. 15 p, 13 fig, 3 tab, 16 ref.

Descriptors: *Snowmelt, *Infiltration, *Runoff, *Tracers, Tritium, Tracking techniques, Hydrologic budget, Groundwater movement, Recharge, Base flow, Snow management, Snow surveys, Hydrograph analysis, Recession curves, Snowpacks.
Identifiers: Czechoslovakia, Oxygen isotopes, Snow hydrology, Modry Dul basin (Czechoslovakia).

During 1965-1967 the snowmelt runoff in a small mountain basin in northern Czechoslovakia was studied by measuring the tritium and oxygen-18 content of precipitation, snowpack, and runoff, in addition to an improved degree-day method which was used as a standard tool. About two-thirds of the meltwater infiltrated to the soil, and displaced water recharged during the previous years toward the stream channels. The tritium content of the baseflow and the subsurface runoff indicated that the mean residence time of the subsurface water in the basin was approximately 2.5 years with a standard deviation of 1.25 years. The volume of the subsurface storage was estimated to be 2.6 million cu m. The oxygen-18 content of snow samples was in agreement with the tritium results on the relative contribution of the meltwater and subsurface runoff to the total runoff from the basin. (Knapp-USGS)
W70-05673

DEUTERIUM VARIATIONS IN AN ANNUAL SNOWPACK,
Colorado State Univ., Fort Collins; and Geological Survey, Denver, Colo.
Clark Judy, and James R. Meiman.
Water Resources Research, Vol 6, No 1, p 125-129, February 1970. 5 p, 1 fig, 2 tab, 9 ref.

Descriptors: *Snowpacks, *Deuterium, *Snowmelt, *Tracking techniques, Hydrologic cycle, Streamflow, Evaporation, Infiltration, Recharge, Groundwater movement, Precipitation (Atmospheric), Runoff, Data collections, Stable isotopes.
Identifiers: Snowpack metamorphism.

Deuterium samples taken during the 1967-68 snow year in the Rocky Mountains of Colorado indicate that metamorphism and melt of the snowpack greatly reduce the large initial variability in deuterium content of individual snowfalls. New snow values ranged from -229 parts per thousand to -106 parts per thousand D relative to SMOW (Standard Mean Ocean Water). The range in the snowpack profile on May 3, 1968, was -182 to -158. This homogenization would reduce the problems involved in following snowmelt through the hydrologic system. (Knapp-USGS)
W70-05674

THERMAL CONDUCTIVITY OF SNOW BY A TRANSIENT STATE PROBE METHOD,
New Brunswick Univ., Fredericton.
H. Jaafar, and J. J. C. Picot.
Water Resources Research, Vol 6, No 1, p 333-335, February 1970. 3 p, 3 fig, 1 tab, 6 ref.

Descriptors: *Thermal conductivity, *Snow, *Instrumentation, On-site tests, Thermal properties, Ice, Heat transfer, Temperature, Snowpacks.
Identifiers: Thermal conductivity probe.

A transient state thermal conductivity probe (1/4 inch in diameter, 30 inches in length) is described along with the method by which it is used to measure conductivity of snow. Heat is supplied electrically at a constant rate to the probe at a given time after insertion into the sample. After a 4 minute lag, a plot of probe temperature rise against logarithm of time since the start of heating, gives a straight line whose slope is inversely proportional to sample thermal conductivity and proportional to the heating rate. The probe was calibrated against a standardized oil, and the constant was found to be unity. Values for artificially packed snow in the laboratory agreed with published data. However, values found in the field were considerably lower. The device is recommended for field measurements since data can be obtained with minimum disturbance of the snow. (Knapp-USGS)
W70-05695

ON THE EFFECT OF DENSITY INVERSION ON NATURAL CONVECTION IN A MELTED WATER LAYER,
Army Terrestrial Science Center, Hanover, N.H.
Yin-Chao Yen.
Heat Transfer-Philadelphia, Chemical Eng. Progress, Symposium Series, AIChE, 92, Vol. 65, 1969, p245-253, 13 fig, 1 tab, 16 ref.

Descriptors: *Heat transfer, Density, Density currents, Convection, Heat flow, Temperature distribution, Thermodynamic behavior, Thermal conductivity, Ice, Melting, Hydrodynamics.

The effect of maximum density of water near 4C on natural convective heat transfer in the water layer resulting from continuous melting of ice has been studied. In one case, the melting process was initiated by applying heat to the bottom surface of the cylindrical ice sample, and, in the other case, by heating the top. Temperature profiles in the continuously increasing water layer and the amount of water flowing into the melting chamber to compensate for the shrinkage due to phase transition were recorded periodically. For the case of melting from the top with warm plate temperature ranging from 4.06C to 25.10C, it was noted that there existed a constant temperature region of about 3.2C. In the water layer independent of the warm plate temperature, TS, and the heat flux, H, at the interface did not depend on TS, but had a constant value of 0.00168 cal/ (sq.cm.) (sec.). On the other hand, when melting occurred from the bottom, it was found there also existed a constant temperature region, which was dependent on TS. The heat flux was found to be strongly dependent on TS and can be represented by $H = 0.0026$ (T sq.) for TS in the range from 7.70 to 25.50C. A relation between Nusselt number and Rayleigh number was found to exist and could be expressed as $NNu = 0.0804$ (NRa to the 1/3 power). (Novotny-Vanderbilt)
W70-05796

THE PROPAGATION OF DISTURBANCES ON GLACIERS,
Case Western Reserve Univ., Cleveland, Ohio.
Wilbert Lick.
Journal Geophysical Research, Vol 75, No 12, p 2189-2197, April 20, 1970. 9 p, 4 fig, 27 ref.

Descriptors: *Glaciers, *Flow, *Mathematical models, Streamflow, Viscosity, Ice, Convection, Rheology, Regimen, Cryology.
Identifiers: Non-Newtonian flow, Glacier surges.

Simplified models of the time-dependent propagation of disturbances on glaciers are analyzed. A brief discussion of the application to river flows is included. A one-dimensional, time-dependent model including nonlinear convective effects is first presented. A two-dimensional, time-dependent model is then discussed and limiting solutions for short- and long-wavelength disturbances are given. It is shown that short-wavelength disturbances diffuse but do not travel relative to the glacier surface. In the long-wavelength approximation, the results are similar to the results from the one-dimensional model but additional details of the flow field are obtained. Surface height and speed are calculated for specified conditions at the ice-rock interface. (Knapp-USGS)
W70-05888

DYNAMICS OF SNOW AVALANCHE (WITH ESTIMATION FOR FORCE ON A BRIDGE),
Colorado State Univ., Fort Collins. Dept. of Civil Engineering; and Rose Polytechnic Inst., Terre Haute, Ind. Dept. of Mathematics.
H. W. Shen, and A. T. Roper.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 7-26, March 1970. 20 p, 9 fig, 20 ref.

Descriptors: *Avalanches, *Snow, *Mathematical models, Recreation, Highways, Engineering structures, Bridges, Structural engineering, Design, Mathematical studies, Fluid mechanics.
Identifiers: Avalanche forces, Avalanche forecasting.

Critical conditions for the occurrence of snow avalanches are reviewed and summarized. Physical descriptions of slab avalanche, power avalanche and mature powder avalanche are given. A two-dimensional dynamic model based on a fluid mechanics principle describes snow avalanche. The vertical distribution of pressure forces above ground is estimated from this model based on some of the empirical relationships determined by A. Voellmy. Estimations of the forces exerted by a snow avalanche on a proposed bridge are given. (Knapp-USGS)
W70-05896

RECISSION COEFFICIENT IN GLACIER RUNOFF STUDIES,
Swiss Federal Inst. for Snow and Avalanche Research, Davos/Weissfluhjoch; and Hydraulic Research Inst., Prague (Czechoslovakia).
Jaroslav Martinec.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 87-90, March 1970. 4 p, 2 fig, 4 ref.

Descriptors: *Glaciers, *Melting, *Recession curves, *Ablation, Temperature, Correlation analysis, Hydrograph analysis, Mathematical studies, Runoff forecasting.
Identifiers: Glacier runoff.

The use of recession coefficient in the assessment of glacier and snowmelt runoff with regard to temperature is discussed. The variability of this coefficient due to various factors is explained. Relations between the daily glacier runoff volumes and the respective meteorological conditions are affected by the lag factor. If only a part of the melted water leaves the catchment area within the first 24 hours, the glacier runoff continues even with no further melting taking place. (Knapp-USGS)
W70-05902

THE EFFECT OF ALBEDO-REDUCING MATERIALS ON NET RADIATION AT A SNOW SURFACE,
Forest Service (USDA), Ogden, Utah; Forest Service (USDA), Fort Collins, Colo.; and Colorado State Univ., Fort Collins. Dept. of Watershed Resources.
For primary bibliographic entry see Field 03B.
W70-05903

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION AND MICROCLIMATE OF IRRIGATED PASTURES AND ALFALFA UNDER HIGH ALTITUDE CONDITIONS,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
R. D. Burman, and T. L. Loudon.
American Society of Agricultural Engineers, Transactions, Vol 11, No 1, p 123-125, 128, January-February 1968. 6 fig, 6 tab, 5 ref.

Descriptors: *Evapotranspiration, *Microclimatology, *Irrigated land, *Irrigation effects, *Pastures, Alfalfa, Wheatgrasses, Arid lands, Wyoming, Altitude, Air circulation, Cloud cover, Crop response, Energy budget, Solar radiation.
Identifiers: *Energy-balance components, *Farson Pilot Farm, Wyoming, *Cool steppes, *Red Desert, Wyoming, Eden Project, Ryegrasses.

Studies were undertaken in 1962-1966 to investigate evapotranspiration and microclimate of high-altitude irrigated pastures. It was found that evapotranspiration from ryegrass-alfalfa pastures was higher than evapotranspiration from wheatgrass-alfalfa pastures, except for a 1-hr midday period when it was lower for the ryegrass-alfalfa mixture. The greatest evapotranspiration difference between crops occurred in the afternoon. Crop evapotranspiration was influenced considerably more by sky conditions than by application of irrigation. Energy-balance components were much higher in bright sunshine than under cloudy skies. Air over the pasture was unstable until late afternoon, with most of the evapotranspiration occuring during the period of instability. (Carr-Arizona)
W70-05590

EFFECTS OF KAOLINITE AS A REFLECTIVE ANTITRANSPIRANT ON LEAF TEMPERATURE, TRANSPIRATION, PHOTOSYNTHESIS, AND WATER-USE EFFICIENCY,
California Univ., Davis.
Antoine Abou-Khaled, Robert M. Hagan, and David C. Davenport.
Water Resources Research, Vol 6, No 1, p 280-289, February 1970. 10 p, 11 fig, 32 ref. OWRR Project B-054-CAL.

Descriptors: *Transpiration control, *Evapotranspiration control, *Kaolinite, Consumptive use, Water conservation, Light intensity, Soil-water-plant relationships.
Identifiers: Antitranspirants.

Transpiration and photosynthesis are influenced by the optical properties of leaves. Application of a uniform white coating of kaolinite to the upper leaf surface produced significant changes in the spectral curves (reflectivity, transmissivity, and absorptivity) of Valencia orange leaves. Photosynthetic light response curves of leaves of orange, lemon, rubber plant (all hypostomatous), and bean (amphibiostomatous) were modified by the reflective material, which at low light intensities decreased photosynthetic rates and increased light saturation levels. The white coating cooled the leaves 3-4 deg C and reduced transpiration 22-28% under conditions of high light intensity, warm air, low relative humidity, and low wind velocity. However the rubber plant under the same conditions showed a smaller reduction in transpiration (less than 10%), indicating effective self-regulation of its water loss. These experiments demonstrated that water-use efficiency of leaves can be improved, particularly under high light intensities. (Knapp-USGS)
W70-05635

EVAPOTRANSPIRATION FROM BARE, HERBACEOUS, AND ASPEN PLOTS: A CHECK ON A FORMER STUDY,
Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W70-05693

EVAPORATION IN EAST AFRICA,
East African Agriculture and Forestry Research Organization, Nairobi (Kenya). Physics Div.; and Cotton Research Corp., Kampala (Uganda).
M. Dagg, T. Woodhead, and D. A. Rijks.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 61-67, March 1970. 7 p, 2 fig, 51 ref.

Descriptors: *Evaporation, *Meteorological data, *Environmental effects, *Evapotranspiration, Synoptic analysis, Temperature, Climates, Climatic data, Water demand, Water balance, Hydrologic cycle.
Identifiers: *Penman evaporation estimation, *Africa.

Following a decision to estimate potential evaporation from meteorological observations rather than from evaporation pans, 53 agricultural meteorological stations were established over East Africa with the cooperation of several departments of three governments. Supplementary information from an additional 123 less well equipped stations was incorporated into the preparation of maps of monthly potential open water evaporation, using the Penman estimate. Annual values of potential evaporation range from more than 2,600 mm to less than 1,400 mm with 70% of the area of East Africa having potential evaporation rates of between 1,800 and 2,200 mm per annum. There are marked seasonal variations in evaporation rates, mainly dependent on patterns of cloud cover, but average monthly rates rarely fall below 90 mm even in highland areas. These high rates of water demand have serious implications for the management of water catchments, land planning, crop breeding, tillage techniques, groundwater recharge and rates of primary productivity in rangeland. (Knapp-USGS)
W70-05900

2E. Streamflow and Runoff

METEOROLOGICAL DROUGHT IN IDAHO AS EXPRESSED BY THE PALMER INDEX,
Weather Bureau, Salt Lake City, Utah. Western Region.
For primary bibliographic entry see Field 02B.
W70-05601

METEOROLOGICAL DROUGHT IN MONTANA AS EXPRESSED BY THE PALMER INDEX,
Weather Bureau, Salt Lake City, Utah. Western Region.
For primary bibliographic entry see Field 02B.
W70-05602

GEOLOGICAL SURVEY RESEARCH 1969, CHAPTER A.
Geological Survey, Washington, D.C.

Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $4.00. Geological Survey Professional Paper 650-A, 1969. 425 p, 11 fig, 79 ref, 3 index.

Descriptors: *Hydrogeology, *Hydrology, *Geology, *Research and development, Bibliographies, Surveys, Reviews, Publications, Water resources.
Identifiers: US Geological Survey Research (1969).

'Geological Survey Research 1969,' the tenth annual review of the economic and scientific work of the U. S. Geological Survey, consists of four chapters (A through D) of Professional Paper 650. Chapter A summarizes significant results, and the remaining chapters consist of collections of short technical papers. Some, but not all, of the results summarized in chapter A are discussed in more detail in the short technical papers of chapters B through D, or in reports listed in 'Publications in Fiscal Year 1969.' (Knapp-USGS)
W70-05639

A FINITE ELEMENT SOLUTION OF THE ONE-DIMENSIONAL DIFFUSION-CONVECTION EQUATION,
California Univ., Davis.
For primary bibliographic entry see Field 08B.
W70-05681

A GRAPHIC PRESENTATION OF STREAM GAIN OR LOSS AS AN AID IN UNDERSTANDING STREAMFLOW CHARACTERISTICS,
Geological Survey, Huron, S. Dak.
Neil C. Koch.
Water Resources Research, Vol 6, No 1, p 239-245, February 1970. 7 p, 4 fig, 7 ref.

Descriptors: *Streamflow, *Surface-groundwater relationships, Base flow, Infiltration, Water loss, Hydrograph analysis, Hydrology, Hydrogeology.
Identifiers: Graphic methods, James River (N Dak).

A graphic presentation of cumulative monthly stream gain or loss on a given stream reach is used as a tool to show whether the stream gain or loss is apparent or real, and to determine the magnitude, time, and cause of the gain or loss. The graphic method could also be used to determine how much of the base flow is groundwater discharge. Interpretations of the cumulative gain or loss graph are described for three reaches on the James River in northeastern South Dakota and southeastern North Dakota. (Knapp-USGS)
W70-05687

ON THE HIERARCHIAL STRUCTURE OF NATURAL DRAINAGE SYSTEMS,
For primary bibliographic entry see Field 04A.
W70-05689

STREAM TEMPERATURE PREDICTION MODEL,
Bonneville Power Administration, Portland, Oreg.
For primary bibliographic entry see Field 02A.
W70-05690

A TECHNIQUE OF GENERATING A SYNTHETIC FLOW RECORD TO ESTIMATE THE VARIABILITY OF DEPENDABLE FLOWS FOR A FIXED RESERVOIR CAPACITY,
North Carolina State Univ., Raleigh; and Virginia Polytechnic Inst., Blacksburg.
N. V. Colston, and J. M. Wiggert.
Water Resources Research, Vol 6, No 1, p 310-315, February 1970. 6 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Synthetic hydrology, *Streamflow forecasting, *Reservoir design, *Cost-benefit analysis, Mathematical models, Statistical models, Rainfall-runoff relationships, Computer programs, Regression analysis.
Identifiers: James River (Va.).

The variability of dependable flows for fixed storage should be incorporated into the economic analysis of a water resource storage project. Flow values representative of the James River were computed by a hydrologic model that uses data randomly generated from monthly precipitation distributions. Dependable flows from fixed storage were found to have large variance. Confidence limits placed on the dependable flows illustrate the wide range of possible dependable flows for a specified reservoir size. Benefit-cost ratios for water resource projects should be expressed in terms of confidence limits. (Knapp-USGS)
W70-05692

THE FLOW INTERVAL METHOD FOR ANALYZING TIMBER HARVESTING EFFECTS ON STREAMFLOW REGIMEN,
Forest Service (USDA), Parsons, W. Va. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 03B.
W70-05694

LENGTH OF STREAM FOR AN INDEPENDENT EVENTS MODEL,
Northwestern Univ., Evanston, Illinois.
For primary bibliographic entry see Field 02A.
W70-05696

DEPENDENCE OF STREAM LINK LENGTHS AND DRAINAGE AREAS ON STREAM ORDER,
Illinois Univ., Urbana.
A. K. Ghosh, and A. E. Scheidegger.
Water Resources Research, Vol 6, No 1, p 336-340, February 1970. 5 p, 2 tab, 9 ref.

Descriptors: *Drainage patterns (Geologic), *Tributaries, Drainage density, Statistical methods, Mathematical studies, Geomorphology, Watersheds (Basins), Channel morphology, Streams, Erosion.
Identifiers: Bifurcation ratio, Stream order.

It has been suggested in the literature that the lengths of interior links (distances along river course between subsequent junctions) in a given river network are independent random variables drawn from the same population. However, the validity of this basic hypothesis with relation to nature had never been investigated. Thus a test was made to find the exact relationship between the stream lengths and the corresponding stream orders by comparing the theoretical length ratios calculated, assuming all link lengths to be equal, and the natural length ratios for rivers with the same number of first order streams. The results show that the link length always has a tendency to increase geometrically with the Strahler order. This leads to the conclusion that a law of link lengths exists that is similar to the well-known laws of stream orders, stream lengths, and areas. A similar analysis with regard to the areas drained by each link in a river network shows that these areas are constant. (Knapp-USGS)
W70-05697

WEEKLY AND NONTHLY FLOWS IN SYNTHETIC HYDROLOGY,
North Carolina Univ., Chapel Hill; and Florida Univ., Gainesville.
For primary bibliographic entry see Field 02A.
W70-05698

TIME-OF-TRAVEL STUDIES IN THE FALL CREEK BASIN, TOMPKINS COUNTY, NEW YORK,
Geological Survey, Albany, N.Y.
Bernard Dunn.
New York State Water Resources Commission Report of Investigation R1-11, 1970. 21 p, 10 fig, 2 tab.

Descriptors: *Streamflow, *Tracking techniques, *Dye releases, *New York, *Low flow, Stream gages, Discharge measurement, Velocity, Discharge (Water), Flow measurement, Duration curves.
Identifiers: *Time of travel, Dye tracing, Fall Creek (N.Y.).

The time of travel of stream water was determined for a 19.9-mile reach of Fall Creek from McLean to the U. S. Geological Survey gaging station near Ithaca, Tompkins County, New York and for a 5.2-mile reach of Virgil Creek from Dryden to its mouth. The time of travel for Fall Creek during a very low discharge of 9 cfs (cubic feet per second) was more than four times as great as when a medium discharge of 100 cfs prevaled. Channel irregularities and manmade obstructions cause the time of travel through a reach to vary erratically during low flows. For moderate discharges the time of travel was much more uniform throughout the reaches studied. Flow-duration curves were developed and are presented for three sites: (1) the gaging stations on Fall Creek near Ithaca; (2) on Fall Creek at McLean; and (3) on Virgil Creek at Freeville. (Dunn-USGS)
W70-05710

EFFECTS OF URBAN DEVELOPMENT ON DIRECT RUNOFF TO EAST MEADOW BROOK, NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04C.
W70-05712

FLOOD PLAIN INFORMATION OF ANDROSCOGGIN RIVER, AUBURN AND LEWISTON, MAINE.
Army Corps of Engineers, Waltham, Mass. New England Div.
For primary bibliographic entry see Field 04A.
W70-05716

UNIT HYDROGRAPHS FOR SOUTHWESTERN LOUISIANA,
Geological Survey, Baton Rouge, La.
V. B. Sauer.
Louisiana Department of Public Works Technical Report No 2d, 1969. 55 p, 13 fig, 4 tab, 32 ref, append.

Descriptors: *Unit hydrographs, *Rainfall-runoff relationships, *Louisiana, Base flow, Recession curves, Drainage patterns (Geologic), Runoff forecasting, Streamflow forecasting, Storm runoff, Frequency analysis, Gaging stations.
Identifiers: Southwestern Louisiana.

Unit hydrograph and base-flow recession data are provided for 27 stream gaging stations in southwestern Louisiana, an area of about 9,000 square miles. These data can be used at the individual sites to estimate, from rainfall excess, flood hydrographs resulting from large storms. Regionalized data provide methods of estimating unit hydrographs at ungaged sites. A single, dimensionless unit hydrograph is applicable to any site in the study area. The basin parameters, size, mean length, and lag time are the factors necessary to convert the dimensionless unit hydrograph to a specific unit hydrograph for a site. Curves of relation between lag time and mean length provide the best estimate of lag time for ungaged sites. These relations define lag time characteristics for three distinct types of streams in the study area: flat and sluggish streams in the south; moderate to sluggish streams in the north; and more flashy streams, such as Little Sandy Creek, in the north. Base-flow recessions for sites in the study area are related, through a family of curves, to basin size only. Two distinct areas, a south area and a north area, are defined by these curves. (Knapp-USGS)
W70-05717

JAMES RIVER BASIN COMPREHENSIVE WATER RESOURCES PLAN, VOLUME I -- INTRODUCTION.
Virginia Dept. of Conservation and Economic Development, Richmond. Div. of Water Resources.
For primary bibliographic entry see Field 06B.
W70-05724

PROFILES OF A REACH OF THE SAN JOAQUIN RIVER BELOW FRIANT DAM, FRESNO AND MADERA COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
Kenneth W. Lee.
Geological Survey Open-file report, September 1969. 5 p, 1 fig, 4 plate, 2 ref.

Descriptors: *Floods, *California, *Profiles, *Flood forecasting, Flood plains, Stage-discharge relations, Reservoir operation, Mapping, Thalweg, Streamflow.
Identifiers: San Joaquin River (Calif), Friant Dam (Calif).

The water-surface profiles for the release of a maximum of 8,230 cfs from Millerton Lake to the San Joaquin River, California and the water-surface profile for the record release of 12,400 cfs are presented. Bank and thalweg profiles are also shown. The reach of river studied extends 37.3 miles downstream from Friant Dam at the outlet of Millerton Lake. Both flood profiles show inundation of some low-lying areas, confirmed by field observation and aerial photographs. Increased vegetative growth in the channel can cause larger areas to be inundated in the future, particularly in the lower parts of the reach. The depth-reducing effect of localized channel-clearing operations between the two release periods is evident when the two profiles are compared. (Knapp-USGS)
W70-05725

SECONDARY FLOWS IN CURVED OPEN CHANNELS,
Kyoto Univ. (Japan). Disaster Prevention Research Inst.
For primary bibliographic entry see Field 08B.
W70-05739

ON THE DEVELOPMENT OF STREAM MEANDERS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
Alvin G. Anderson.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A46, p 370-378, 1967. 9 p, 8 fig, 13 ref.

Descriptors: *Channel morphology, *Meanders, *Alluvial channels, *Discharge (Water), Sediment load, Mathematical studies, Statistical models, Bed load.
Identifiers: Meander development.

An analysis was made to relate the mean length of alternate bars in straight alluvial channels and hence the meander length of meandered streams to the flow parameters. Based upon a concept of transverse oscillations, the relative meander length is related to the Froude number of the mean flow and through the Froude number to the discharge. These results are compared with experimental data for the meanders generated in laboratory channels at constant discharge with generally good agreement. The analysis also suggests that there is no unique relationship between meander length and discharge. (Knapp-USGS)
W70-05740

MODEL SIMILARITY AND TRAINING OF RIVER WITH LARGE CHANNEL IRREGULARITIES,
Hydraulic Research Inst., Prague (Czechoslovakia). Dept. of Technical Hydromechanics.
Pavel Novak.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A47, p 379-388, 1967. 10 p, 4 fig, 4 ref.

Descriptors: *Model studies, *Alluvial channels, Hydraulic models, Channel morphology, River training, Simulation analysis.
Identifiers: Aerodynamic model studies, Model scale effects.

The conditions for similarity of open channel flows are outlined in a discussion of the criteria for the construction of hydraulic models of alluvial channels. The relationship of large irregularities in channel shape to the value of the friction coefficient is given and related to prototype behavior. The effects of river training on friction losses in models and streams are calculated. Aerodynamic analogies may be useful in hydraulic model studies. Some aspects of aerodynamic models of streams are discussed. (Knapp-USGS)
W70-05741

SOME RELATIONS OF ENERGY, ROUGHNESS, AND CHANNEL GEOMETRY IN THE LOWER MISSISSIPPI RIVER,
Corps of Engineers, Vicksburg, Miss.
Malcolm G. Anding, and Paul W. Pierce, III.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A48, p 389-397a, 1967. 10 p, 5 fig, 1 tab, 7 ref.

Descriptors: *Channel morphology, *Hydraulics, *Mississippi River, Surveys, Discharge measurement, Mapping, Roughness (Hydraulic), Sediment transport, Alluvial channels, River training, Flood control.
Identifiers: Mississippi channel geometry.

Extensive surveys and investigations are being conducted on the Lower Mississippi River. Improved surveying and drafting procedures now permit more detailed coverage by hydrographic surveys, discharge measurements, bed profiles, and water surface profiles. The objectives of these investigations include isolation and study of the principal hydraulic variables related to transport of water and sediment in large alluvial streams, development of design criteria for river control structures, and analyses of the effects of existing and proposed channel stabilization structures. The basic studies and investigations are described and related to channel types and alignment encountered in the lower river. An energy-roughness concept is given with discussions of the important variables which are believed directly related to the energy slope. Data are presented for two representative reaches of the Mississippi River permitting comparisons of these variables. (Knapp-USGS)
W70-05742

THE ROLE OF SECONDARY CURRENTS IN HYDRAULICS,
Pittsburgh Univ., Pa. School of Engineering.
Chao-Lin Chiu.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A51, p 415-421, 1967. 7 p, 2 fig, 6 ref.

Descriptors: *Open channel flow, *Flow characteristics, *Hydraulics, Turbulent flow, Steady flow, Fluid mechanics, Boundary processes, Channel morphology, Vortices, Water circulation.
Identifiers: Noncircular conduits, Secondary flows.

The role of secondary currents in several areas of hydraulics is described and discussed. The mechanics governing the existence of secondary currents in straight noncircular channels is also presented. The major part of the discussion is based on analytical equations of secondary flow velocities and results of applying a semiempirical method for calculating the sediment concentration under the influence of secondary currents. (Knapp-USGS)
W70-05743

AN APPROXIMATE THEORY OF SECONDARY FLOWS AT THE BEND OF THE RIVER COURSE,
American Inst. of Water Problems and Hydrotechnics, Yerevan (USSR).
A. K. Ananian.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A52, p 422-428, 1967. 7 p, 1 fig, 1 ref.

Descriptors: *Vortices, *Meanders, *Alluvial channels, Open channel flow, Mathematical studies, Boundary processes, Turbulence, Turbulent flow, Channel morphology, Steady flow, Water circulation.
Identifiers: *Secondary flows.

A general differential equation of secondary flows with coaxial currents at any cross section of bends of river courses is deduced from known approximate equations for turbulence. Boundary conditions of integration are formulated and variational methods of solving the task are suggested. The solution of a particular problem relating to the secondary flow in a rectangular river course is considered. (Knapp-USGS)
W70-05744

SECONDARY CURRENTS IN CURVED STRATIFIED RIVERS,
Manchester Univ. (England). Inst. of Science and Technology.
L. N. Chikwendu.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A54, p 438-446, 1967. 9 p, 5 fig, 4 ref.

Descriptors: *Vortices, *Meanders, *Alluvial channels, Open channel flow, Mathematical studies, Boundary processes, Turbulence, Turbulent flow, Channel morphology, Steady flow, Water circulation, Model studies, Hydraulic models, Currents (Water).
Identifiers: *Secondary flows.

Although numerous papers dealing with secondary currents have been published in the past, all of these have been for conditions where the fluid was homogeneous in density. The present paper describes a series of laboratory experiments pertaining to the patterns, magnitudes, and mixing effects of secondary currents in curved density-stratified rivers. The angle made by the stream on the bed, a good measure of the strength of the secondary current, has been correlated by means of empirical equations to fluid flow, and channel geometric properties. (Knapp-USGS)
W70-05745

SECONDARY CURRENTS IN THE NEWCASTLE HARBOUR SILTATION INVESTIGATION,
Department of Public Works, Sydney (Australia). Hydraulic Lab.; and Department of Public Works, Sydney (Australia). Maritime Service Board.
For primary bibliographic entry see Field 02J.
W70-05746

SOME ASPECTS OF FLOW IN MEANDERING CHANNELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A57, p 465-471, 1967. 7 p, 3 fig, 4 ref.

Descriptors: *Flow, *Alluvial channels, *Vortices, *Meanders, Open channel flow, Model studies, Mathematical studies, Turbulence, Mass transfer, Channel morphology, Currents (Water).
Identifiers: Secondary flows.

The flow in a meandering stream differs from that in a straight channel by the curvilinear characteristics of the former. The fact that the spiral motion is one of the most important characteristics of the flow in a meandering channel and that the effect of the bend extends both upstream and downstream has been conformed by experiments. As the flow pattern changes from section to section, in general there is a lateral mass transfer through any longitudinal section, although its magnitude is usually small compared to the longitudinal mass transfer. The water surface profiles also vary with sections. Moreover, for flow in a meandering channel with bends connected by relatively short tangents, there often exist two or even more spirals. (Knapp-USGS)
W70-05747

THE STABLE PROFILES OF THE CURVED OPEN CHANNEL BEDS,
Public Works Research Inst., Tokyo (Japan).
For primary bibliographic entry see Field 02J.
W70-05749

ON THE THEORY OF EVOLUTION OF RIVER NETS,
Geological Survey, Urbana, Ill.
For primary bibliographic entry see Field 02A.
W70-05879

DRAINAGE DENSITY IN DRIFT-COVERED BASINS,
Washington State Univ., Pullman. Dept. of Engineering.
John F. Orsborn.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7033, p 183-192, January 1970. 10 p, 6 fig, 4 tab, 10 ref, append.

Descriptors: *Drainage density, *Drainage patterns (Geologic), *Glacial drift, *Floods, Geomorphology, Wisconsin, Frequency analysis, Water balance, Streamflow, Dimensional analysis, Correlation analysis, Base flow, Flood forecasting, Geology, Hydrology.
Identifiers: Big Eau Pleine basin (Wis).

Drainage density, as determined for three drift-covered basins in north-central Wisconsin, has been correlated with mean annual flood flows and base flows. Deviations in the relationship for base flow from two basins are caused by groundwater gains and losses. Correcting for these deviations, drainage density has been related to the streamflow components of surface runoff and groundwater flow, taken as a percentage of total annual runoff. The original analysis of the data, and dimensional analysis, indicate that these streamflow components should be related to drainage density by a power function. This function is not continuous, and therefore a semilogarithmic relationship is developed which satisfies the basic requirement that the sum of surface runoff and baseflow must be total streamflow. The results are indicative of the influences of the soils and geology of the three basins on the streamflow components. (Knapp-USGS)
W70-05884

BED TOPOGRAPHY EFFECT ON FLOW IN A MEANDER,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 8B.
W70-05887

WATER RESOURCES OF NORTHWESTERN ST. LANDRY PARISH AND VICINITY, LOUISIANA,
Geological Survey, Baton Rouge, La.
R. L. Hosman, W. L. Broussard, and A. J. Calandro.
Louisiana Geological Survey and Department of Public Works Water Resources Pamphlet No 23, January 1970. 29 p, 1 plate, 5 tab, 18 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Louisiana, Streamflow, Water quality, Aquifers, Duration curves, Water yield, Hydrographs, Water wells.
Identifiers: St. Landry Parish (La).

Water of good chemical quality is available from both surface water and groundwater sources to residents of the northwestern St. Landry Parish area, Louisiana. Two streams, Bayou Cocodrie and the west protection levee borrow pit channel, appear suitable for development of fairly large supplies. Bayou Cocodrie has a mean discharge of 417 cfs or 269 mgd and a minimum discharge of 50 cfs. Dissolved-solids content normally ranges from 30 to 70 mg/liter, hardness from 30 mg/liter, and pH from 7.0 to 7.5. The west protection levee borrow pit channel has a mean discharge of 529 cfs and a minimum discharge of 6.7 cfs. The Chicot-Atchafalaya acquifer blankets the entire area and is capable of sustaining high well yields. It is 150 to 300 feet thick and contains fresh water throughout the area. The water is characteristically hard and high in iron content and requires treatment for many uses. The Evangeline aquifer, which underlies the Chicot-Atchafalaya aquifer, contains fresh water only in the extreme western part of the area where the water is a sodium bicarbonate type, soft, and generally low in iron. (Knapp-USGS)
W70-05889

APPLICATIONS OF CROSSING THEORY IN HYDROLOGY,
Technical Univ. of Denmark, Copenhagen. Hydraulic Lab.
C. F. Nordin, and D. M. Rosbjerg.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 27-43, March 1970. 17 p, 14 fig, 1 tab, 15 ref.

Descriptors: *Time series analysis, *Hydrologic data, *Statistical methods, Streamflow forecasting, Data processing, Mathematical studies, Frequency analysis.
Identifiers: Crossing theory (Statistics).

Annual hydrologic time series, precipitation or runoff, for example, often exhibit marginal distributions that are approximately Gaussian. When this is the case, many interesting properties of the time series can be predicted by the simple techniques of crossing theory, developed by Rice in connection with analysis of the statistical properties of random noise. The theory would seem to be particularly applicable to estimating the lengths of runs above or below a given level and in providing a definitive measure of persistence in hydrologic time series. (Knapp-USGS)
W70-05897

SIMULATION OF STREAMFLOW IN SCOTLAND,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
George Fleming.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 53-59, March 1970. 7 p, 4 fig, 1 tab, 7 ref.

Descriptors: *Simulation analysis, *Synthetic hydrology, *Computer models, Computer programs, Model studies, Mathematical models, Rainfall-runoff relationships, Systems analysis, Parametric hydrology.
Identifiers: *Stanford Watershed model, Scotland, Clyde River.

The application of mathematical models for simulating the processes of the hydrological cycle is considered and the results of applying a translated version of the Stanford Watershed model to the River Clyde in Scotland are presented. The Stanford Watershed model was found to be a very flexible tool for application to the problem of simulating streamflow from rainfall, evaporation and catchment information. Results obtained from the translated version of the model show good agreement between recorded and simulated flows. The application to the Clyde has been shown to be feasible and further application to other streams in Europe should be possible depending on the availability of data. The potential of the model includes possibilities such as flood estimation, irrigation studies, water supply design, weather modification studies, urban drainage design, and the study of effects of urbanization. (Knapp-USGS)
W70-05899

RUNOFF FORECASTING BY VARIABLE TRANSFORMATION,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-05906

BOUNDARY SHEAR DISTRIBUTION IN OPEN CHANNEL FLOW,
Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05907

2F. Groundwater

HYDROCHEMICAL INTERPRETATION OF GROUNDWATER MOVEMENT IN THE RED RIVER VALLEY, MANITOBA,
Department of Energy, Mines and Resources, Ottawa (Ontario).
J. E. Charron.
Inland Waters Branch, Department of Energy, Mines and Resources Scientific Series No 2, Ottawa, Canada, 1969. 31 p, 40 fig, 3 tab, 21 ref.

Descriptors: *Groundwater movement, *Geochemistry, *Hydrogeology, Aquifer characteristics, Geologic control, Aquifers, Water table, Artesian wells, Water chemistry, Water quality.
Identifiers: *Canada, Red River Valley.

A hydrogeological study of the Red River Valley, Manitoba has been in progress for five years. A hydrochemical approach based on the field data is primarily a study of groundwater movement. Groundwater flow is illustrated by means of semilogarithmic diagrams, cross-sections, maps, figures, and tables. Most groundwater is saturated or near saturated in calcium carbonate and not saturated in calcium sulfate. The absolute chloride value is the most important indicator of the degree of sluggishness of a body of groundwater. From recharge to discharge the groundwater tends to become more acidic. In confined aquifers, the direction of groundwater movement can be determined from the hydrochemistry of the groundwater. In a study of this kind there is always the possibility that an understanding of groundwater movement may lead to new mineral discoveries. (Knapp-USGS)
W70-05638

GEOLOGICAL SURVEY RESEARCH 1969, CHAPTER A.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-05639

GEOHYDROLOGIC INTERPRETATIONS OF A VOLCANIC ISLAND FROM ENVIRONMENTAL ISOTOPES,
Geological Survey, Washington, D.C.; Atomic Energy Research Inst., Seoul (South Korea); and International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 02K.
W70-05672

THE MECHANISM OF NATURAL GROUNDWATER RECHARGE AND DISCHARGE: 2. LABORATORY COLUMN EXPERIMENTS AND FIELD MEASUREMENTS,
Department of Energy, Mines, and Resources, Calgary (Alberta). Inland Water Branch.
R. Allan Freeze, and James Banner.
Water Resources Research, Vol 6, No 1, p 138-155, February 1970. 18 p, 10 fig, 3 tab, 19 ref.

Descriptors: *Recharge, *Discharge (Water), *Groundwater movement, *Infiltration, Laboratory tests, Model studies, On-site tests, Surveys, Investigations, Observation wells, Grasslands, Mathematical models, Snowmelt, Precipitation (Atmospheric), Saturated flow, Unsaturated flow, Evaporation, Sands, Hydrologic budget, Water balance.
Identifiers: Canada.

A mathematical model was used to simulate one-dimensional, vertical, unsteady, unsaturated flow above a recharging groundwater flow system. Results from this model were correlated with the results from a laboratory column experiment using a tensiometer-transducer system. On the Canadian prairies, cases of recharge-sustaining infiltration to the water table are isolated in time and space. Only spring snowmelt, and on occasion heavy summer rains, are effective. A large percentage of the snowmelt, however, is at the surface prior to the thawing of the frost wedge and therefore does not infiltrate. Effective infiltration is largely in depressions, and some groundwater recharge areas may never receive direct infiltration to the water table. Observation well hydrographs of water-table fluctuations alone are not sufficient to monitor recharge phenomena; measurements of the hydraulic gradient above and below the water table are necessary. It is erroneous to map a sand or gravel plain as an effective recharge area without first investigating the influence of the unsaturated hydrologic properties of the soil. (Knapp-USGS)
W70-05676

HYDRODYNAMIC INSTABILITY OF MISCIBLE FLUIDS IN A VERTICAL POROUS COLUMN,
Guelph Univ. (Ontario).
Y. Bachmat, and D. E. Elrick.
Water Resources Research, Vol 6, No 1, p 156-171, February 1970. 16 p, 9 fig, 3 tab, 8 ref.

Descriptors: *Saline water intrusion, *Porous media, *Groundwater movement, Dispersion, Diffusion, Hydrodynamics, Model studies, Hydraulic models, Solutes, Mixing, Aqueous solutions, Mathematical models, Tracers, Dye releases, Hydraulic conductivity, Mathematical studies.
Identifiers: Hydrodynamic instability.

A series of experiments have been conducted at a constant temperature on the intrusion of salt from a reservoir containing a fixed volume of solution into an underlying long vertical column of porous material, initially saturated with pure water and sealed at the bottom. The variation with time of the salt concentration in the reservoir was measured for different types of porous materials, different initial concentrations, and different mechanical treatments of the solutions. The experimental results, substantiated by the theoretical analyses, indicate that the main contributor to the influx of salt into the porous material is the convective dispersion arising from the onset of horizontal variations of the salt concentration and of the vertical velocity component. Approximate expressions have been

derived for the rate of decrease of the salt concentration in the reservoir, for the influx of salt into the porous material, and for the advances of the salt front within it. (Knapp-USGS)
W70-05677

THEORY OF MULTIPLE LEAKY AQUIFERS,
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Fisica.
Ismael Herrera.
Water Resources Research, Vol 6, No 1, p 185-193, February 1970. 9 p, 3 fig, 6 ref.

Descriptors: *Groundwater movement, *Aquifers, *Mathematical studies, Aquifer characteristics, Leakage, Aquitards, Hydraulics, Drawdown, Storage, Permeability, Porosity, Water wells.
Identifiers: Multiple leaky aquifer systems.

The equations governing the motion of multiple leaky aquifer systems are transformed to obtain a simpler system suitable for numerical treatment. An essential feature of the method is the introduction of a lag time that occurs because the influence of any aquifer is not transmitted instantly to its neighbors. This approximation is suitable for treating cases for which the conditions on the aquifers vary slowly. The numerical treatment of the resulting system of equations is of the same order of complexity as that for a single aquifer. (Knapp-USGS)
W70-05679

FIELD AND LABORATORY DETERMINATION OF THE HYDRAULIC DIFFUSIVITY OF A CONFINING BED,
Geological Survey, Washington, D.C.
Roger G. Wolff.
Water Resources Research, Vol 6, No 1, p 194-203, February 1970. 10 p, 12 fig, 1 tab, 14 ref.

Descriptors: *Hydrogeology, *Groundwater movement, *Aquitards, *Diffusivity, On-site tests, Laboratory tests, Hydraulic conductivity, Storage coefficient, Observation wells, Piezometers, Model studies, Mathematical models.
Identifiers: Aquifer testing, Hydraulic diffusivity.

Field and laboratory evaluations of the hydraulic diffusivity of a confining bed are presented. The field approach consisted of measuring the head in the confining layer by placing piezometers equipped with differential pressure transducers at different depths in the confining layer. Pumping from the overlying aquifer resulted in an observed head change at the aquifer confining bed interface which for long periods of time could be approximated by a step drawdown. The best fit of observed data to the set of theoretical type curves for the step drawdown solution yields a hydraulic diffusivity 0.029 sq cm/sec. Hydraulic diffusivity values for the natural effective load, as obtained in the laboratory using consolidation techniques, are in general agreement with this result. Hydraulic conductivity values as determined in the laboratory by consolidation and constant flow methods are generally similar for the same sample. Particle size distribution and the clay mineralogy are also given for each sample. (Knapp-USGS)
W70-05680

A STOCHASTIC MODEL OF LONGITUDINAL DIFFUSION IN POROUS MEDIA,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02A.
W70-05683

THE TEMPORAL ALLOCATION OF GROUNDWATER - A SIMULATION APPROACH,
Geological Survey, Washington, D.C., and Resources for the Future, Inc., Washington, D.C.
For primary bibliographic entry see Field 06A.
W70-05699

ANNUAL REPORT ON GROUND WATER IN ARIZONA, SPRING 1968 TO SPRING 1969.
Geological Survey, Tucson, Ariz. Water Resources Div.

Arizona Land Department Water Resources Report No 42, December 1969. 46 p, 33 fig, 1 tab.

Descriptors: *Groundwater, *Water resources, *Arizona, Water levels, Water level fluctuations, Water quality, Model studies, Surveys, Reviews, Investigations, Data collections, Hydrologic data.
Identifiers: Arizona water resources.

The status of Arizona's groundwater resources in 1969 is briefly reviewed. Graphs show water levels in selected wells and estimated annual groundwater pumpage in most of the developed areas in the State. Maps show (1) depth to water in selected wells in spring 1969, (2) change in water levels in selected wells from 1964 to 1969, and (3) potential well production by areas. Samples of groundwater for chemical-quality determinations are obtained on an annual basis from about 35 wells and from many other wells on an intermittent schedule. The temperature of the groundwater is obtained coincident with the sampling. The research studies of the Water Resources Division in Arizona are directed toward the hydrology of arid lands. The national programs, which are supported by Federal funds, include basic research in hydrology and applied research in instrumentation and techniques; these programs directly benefit the State program. Projects being supported by the Federal-State cooperative program are: (1) Effects of vegetation manipulation on surface runoff-Sycamore Creek; and (2) Electrical-analog analysis of Avra Valley. (Knapp-USGS)
W70-05718

USE OF GREEN'S FUNCTION IN GROUNDWATER HYDRAULICS,
Princeton Univ., N.J. Dept. of Hydraulics and Hydrology.
Roger J. M. De Wiest.
Tijdschrift Openbare Werken Van Belgie, No 1, p 7-40, 1968-1969. 34 p, 13 fig, 17 ref, 5 append.

Descriptors: *Groundwater movement, *Equations, *Mathematical studies, *Hydraulics, Porous media, Aquifers, Permeability, Flow, Steady flow, Unsteady flow, Uniform flow, Non-uniform flow.
Identifiers: *Greens functions, Gauss theorem, Groundwater hydraulics.

The construction of the Green's function to solve a partial differential equation of mathematical physics for given boundary (and initial) conditions is accomplished in the classical approach with the help of Green's identities, which are briefly reviewed. The underlying basic theorem is the divergence theorem, sometimes known as Gauss' Theorem or as Green's Theorem. The equations are given for two dimensions but they can easily be extended to three dimensions for steady, unsteady, confined, and free-surface groundwater flow to single wells or interfering arrays of wells. The theory of Green's functions has recently been applied to various special problems in groundwater hydraulics. Among the most interesting investigations are domain variations in channel seepage flow, the general solution of the linearized equations of free surface in porous media, and transient two-phase flow through porous media. (Knapp-USGS)
W70-05719

WATER SUPPLY FOR THE NUCLEAR ROCKET DEVELOPMENT STATION AT THE U. S. ATOMIC ENERGY COMMISSION'S NEVADA TEST SITE,
Geological Survey, Denver, Colo.
R. A. Young.
Geological Survey Open-file Report, August 1969. 43 p, 3 fig, 4 tab, 10 ref.

Descriptors: *Water resources, *Groundwater, *Nevada, Arid lands, Aquifers, Recharge, Water wells, Water utilization, Hydrogeology, Hydrologic data, Data collections, Transmissivity.
Identifiers: Aquifer testing, Jackass Flats (Nev).

The Nuclear Rocket Development Station in Jackass Flats, Nevada occupies approximately 123 sq mi in an intermontane valley bordered by highlands on all sides except for a drainage outlet in the southwestern corner. The area has an average annual rainfall of 4 inches. The only important water-producing unit known in the vicinity is a welded-tuff aquifer, the Topopah Spring Member of the Paintbrush Tuff, which receives no significant recharge. Transmissivity, obtained from pumping tests, ranges from 68,000 to 488,000 gpd per ft. Volume of the saturated part of the aquifer is about 3.5 cu mi and the average specific yield probably ranges from 1% to 5%. The volume of groundwater in storage is probably within the range of 37 to 187 billion gallons. This large amount of water should be sufficient to supply the needs of the Nuclear Rocket Development Station for many years. Present average consumption of water is 520,000 gpd, all supplied by one well. This supply well and a standby well have a production capability of 1.6 mgd, adequate for present needs. (Knapp-USGS)
W70-05720

GROUNDWATER DISCHARGE FROM THE EDWARDS AND ASSOCIATED LIMESTONES, SAN ANTONIO AREA, TEXAS, 1968,
Geological Survey, San Antonio, Tex.
Celso Puente.
Edwards Underground Water District Bulletin 20, July 1969. 5 p, 1 tab, 8 ref.

Descriptors: *Springs, *Discharge (Water), *Texas, Water utilization, Aquifers, Limestones, Karst.
Identifiers: Edwards Limestone (Tex).

The 1968 average discharge from the Edwards and associated limestones of Texas is tabulated by county area and by use. Springs include San Marcos Springs in Hays County, Comal Springs in Comal County, San Antonio and San Pedro Springs in Bexar County, and the Leona River Springs in Uvalde County. The recorded discharge for Leona River Springs includes underflow. (Knapp-USGS)
W70-05721

IRON IN GROUND WATERS OF THE MAGOTHY AND RARITAN FORMATIONS IN CAMDEN AND BURLINGTON COUNTIES, NEW JERSEY,
Geological Survey, Trenton, N.J.
For primary bibliographic entry see Field 02K.
W70-05723

DATA FOR SPRINGS IN THE COLORADO DESERT AREA OF CALIFORNIA,
Geological Survey, Menlo Park, Calif.
C. F. Berkstresser, Jr.
Geological Survey Open-file Report, 1969. 13 p, 1 fig, 54 ref, 2 append.

Descriptors: *Springs, *California, Groundwater, Water quality, Discharge (Water), Water yield, Water resources, Water utilization, Data collections, Hydrologic data.
Identifiers: Colorado Desert (California).

Basic data are provided about selected springs in the Colorado Desert of California north of the Mexican border. The report includes description of the springs and the results of analyses of water from the springs. Temperature and pH were measured at the spring site and ammonium was determined qualitatively in the field since January 1963. Flow from springs was measured or estimated, depending on the situation at each site. The location of each site was determined on topographic or other available maps. Chemical and spectrographic analyses were made. Analyses include most of the major, minor, and trace inorganic constituents that occur in natural water. (Knapp-USGS)
W70-05726

METHODS OF GROUNDWATER BALANCE EVALUATION APPLIED IN THE USSR - DEVELOPMENT OF METHODS OF STUDY OF GROUNDWATER BALANCE,
G. V. Bogomolov, B. I. Kudelin, A. V. Lebedev, N. A. Plotnikov, and O. V. Popov.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 135-148, 1968. 14 p, 1 ref.

Descriptors: *Water balance, *Aquifers, *Methodology, *Water resources, Porous media, Artesian wells, Thermodynamic behavior, Aeration, Condensation, Vapor pressure, Salt balance, Heat balance, Dating, Radioisotopes, Model studies.
Identifiers: Soviet Union, Groundwater balance.

The study of the groundwater balance requires an improvement of regional and local methods. Recharge into aquifers, outflow of water from artesian basins, and exchange of water between different aquifers following thermodynamic changes are to be taken into consideration. Other factors to be considered are: (1) Role of condensation water in the aerated zone; (2) role of the vapor phase; (3) salt and heat balance in different environments; (4) tectonic processes; and (5) artificial replenishment of groundwater resources. Natural and artificial isotopes used for dating groundwater and model studies are other methods indicated for evaluation of groundwater. (Carstea-USGS)
W70-05727

THE PRINCIPAL CRITERIA OF THE ANALYSIS OF GEOPHYSICAL FIELDS IN HYDROGEOLOGICAL INVESTIGATIONS WITH SPECIAL REFERENCE TO DESERT REGIONS OF KAZAKHSTAN,
Kazakhstan Geophysical Agency, Alma-Ata (USSR); and All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 07B.
W70-05728

THE MAIN PROBLEMS OF STUDYING THE GROUNDWATER REGIME IN THE U.S.S.R.,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
A. A. Konoplyanstev, and V. S. Kovalevsky.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 244-248, 1968. 5 p, 19 ref.

Descriptors: *Groundwater movement, *Water supply, *Hydrodynamics, Methodology, Aeration, Mathematical models, Statistical methods, Irrigated lands, Acid mine water, Networks, Observation wells, Instrumentation, Salt balance, Irrigation, Water supply.
Identifiers: *Soviet Union, Multiple groundwater use.

During the last 20-25 years, the main studies of groundwater in the Soviet Union involved: (1) Development of hydrodynamic fundamentals and methods of analysis, and prediction of the groundwater regime; (2) new methods of studying the elements of unconfined groundwater, moisture dynamics and the water balance in the aeration zone; (3) application of statistical methods and development of different mathematical models. The hydrogeological stations of the Ministry of Geology provide data for: (1) Prediction and evaluation of multiple groundwater use; (2) water supply and irrigation; (3) salt balance in irrigated areas; and (4) acid mine drainage and related problems. There is a special emphasis on the following aspects of groundwater studies: (1) theory of the origin and movement of groundwater; (2) development of regional networks of observation wells and stations; (3) automation of data collecting instruments. (Carstea-USGS)
W70-05729

METHODS OF GROUNDWATER UNSTEADY FLOWS THEORY,
Akademiya Nauk SSSR. Dept. of Applied Hydrodynamics.
P. Y. Kochina-Polubarinova, Y. S. Dzekster, V. G. Pryazhinskoya, Y. V. Sherban, and V. N. Emikh.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 239-243, 1968. 5 p, 4 fig.

Descriptors: *Groundwater movement, *Unsteady flow, Free surfaces, Equations, Methodology, Flow, Mathematical studies.
Identifiers: Boussinesq's equation.

The study of free surface flow described by Boussinesq's equation is an essential part of groundwater unsteady flows theory. These problems are reduced to the determination of free surface flows or to the determination of physical parameters. Analytical solutions of Boussinesq's equation can be successfully obtained only through some special solutions. In most practical problems, numerical integration of the equation may be accomplished by available finite differential solutions. Splitting multidimensional equations into one-dimensional equations provide the most efficient solutions. The direct method of determining the physical parameters is preceded by the integration of Boussinesq's equation if this proves to be possible. If not, then one of the approximation methods is used. (Carstea-USGS)
W70-05730

THE METHODS OF STUDYING THE FREE UNCONFINED GROUNDWATER REGIME IN IRRIGATION REGIONS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 04B.
W70-05731

ESTIMATION OF GROUNDWATER BALANCES IN ENGLAND,
Institute of Geological Sciences, London (England).
For primary bibliographic entry see Field 07C.
W70-05732

METHODS OF STUDY OF THE GROUNDWATER BUDGET IN NORTH AMERICA,
R. N. Farvolden.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 108-125, 1968. 18 p, 6 fig, 1 tab, 61 ref.
OWRR Project A-013-ILL.

Descriptors: *Water resources, *Water management (Applied), Decision making, Basins, Safe yield, Water yield, Reservoirs, Aquifers, Brines, Base flow, Hydrogeology.
Identifiers: *Groundwater balance, Groundwater budget.

The concept of the groundwater budget is simple and essential to understanding of the hydrologic cycle. Budget studies can also contribute to the understanding of such features as base flow and the origin of brines in deep aquifers. Generally, early studies led to reasonable estimates of many of the parameters of the budget equation. In contrast, modern research is directed to better and simultaneous measurement of these parameters. The author believes that the factors in the groundwater budget are not important in development of a groundwater reservoir. Further, the concept of 'safe yield' is misleading and if there is such a thing for regional aquifers, it cannot be measured or managed. The paper discusses the following topics: (1) Drainage basin; (2) basin studies; (3) regional studies; (4) budget studies of aquifers; and (5) individual terms of the groundwater budget equation. Good water resources management and the budget are the basis for all decision making. (Carstea-USGS)
W70-05733

THE USE OF AIRPHOTO-INTERPRETATION TECHNIQUES IN WATER RESOURCES SURVEYS,
For primary bibliographic entry see Field 07B.
W70-05734

THE ARCHIVES FOR GROUNDWATER LEVELS T.N.O. IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, The Hague (Netherlands).
For primary bibliographic entry see Field 07C.
W70-05735

PRINCIPLES ON NETWORK DESIGN AND BASIC DATA TO STUDY GROUNDWATER BALANCE,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 07A.
W70-05736

GEOLOGY, HYDROLOGY, AND QUALITY OF WATER IN THE HANFORD-VISALIA AREA, SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
M. G. Croft, and G. V. Gordon.
Geological Survey Open-file report, April 1968. 63 p, 9 fig, 15 plate, 5 tab, 65 ref.

Descriptors: *Water resources, *Hydrogeology, *Groundwater, *California, Aquifers, Irrigation water, Water supply, Groundwater movement, Water quality, Water chemistry, Water wells, Water utilization, Hydrologic budget.
Identifiers: Hanford (Calif), Visalia (Calif), San Joaquin Valley (Calif).

The Hanford-Visalia area is in the southeastern part of the San Joaquin Valley, about 30 miles south of Fresno, Calif. The aquifer system contains groundwater under unconfined, semiconfined, and confined conditions. In general, groundwater is unconfined in the oxidized older alluvium, the younger alluvium, and in the flood-basin deposits. Groundwater is semiconfined in the oxidized and reduced continental deposits and in the reduced and some of the oxidized older alluvium. Confined aquifers occur in the reduced continental deposits and reduced older alluvium below and between impermeable lacustrine clays in the vicinity of Tulare Lake Bed. Irrigation water supply exceeded demand in the wet years and was deficient in dry years. Deficiencies were made good with water pumped from underground storage. Water levels in the Hanford-Visalia area generally declined during this period. Gross groundwater withdrawal is estimated to be 1,240,000 acre-ft in the 1955-56 water year and 2,070,000 acre-ft in the 1959-60 water year. Groundwater in the unconsolidated deposits beneath the alluvial fans, on the east side of the valley, is generally low in dissolved constituents. Groundwater in the oxidized older alluvium and younger alluvium is generally of the calcium bicarbonate type. In the axial trough, groundwater is generally high in mineral constituents and the content is variable. (Knapp-USGS)
W70-05737

WATER RESOURCES OF NORTHWESTERN ST. LANDRY PARISH AND VICINITY, LOUISIANA,
Geological Survey, Baton Rouge, La.
For primary bibliographic entry see Field 02E.
W70-05889

PERTURBATION SOLUTION OF IMBIBITION IN A CRACKED POROUS MEDIUM OF SMALL INCLINATION,
Maharaja Sayajirao Univ. of Baroda (India). Dept. of Mathematics.
A. P. Verma.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 45-51, March 1970. 7 p, 15 ref, append.

Descriptors: *Oil-water interfaces, *Porous media, *Groundwater movement, Fractures (Geology), Permeability, Porosity, Capillary action, Capillary water, Flow.
Identifiers: Imbibition.

An oil-water imbibition phenomenon in a slightly dipping cracked porous medium of finite length is analyzed under special conditions. A solution of the nonlinear differential equation describing linear countercurrent imbibition was derived by a perturbation method, and an expression for the wetting phase saturation was obtained. Some specific results for the dependence of relative permeability on phase saturation, impregnation function, oil-water viscosity ratio, and capillary pressure were assumed from standard literature. (Knapp-USGS)
W70-05898

UNSTEADY SEEPAGE TOWARD SINK BENEATH FREE SURFACE,
Washington Univ., Seattle. Dept. of Civil Engineering.
Bruce W. Hunt.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7202, p 859-869, April 1970. 11 p, 4 fig, 8 ref, append.

Descriptors: *Groundwater movement, *Unsteady flow, Water table, Porous media, Aquifers, Hydraulics, Mathematical studies, Seepage, Discharge (Water).
Identifiers: Unsteady seepage.

One of the mathematical techniques of linearized wave mechanics is applied to solve the problem of unsteady, axially symmetric seepage toward a sink of variable strength located beneath a free surface. Both finite and infinite aquifer depths are considered, and linearized solutions are given for two distinct types of problems. The first solution corresponds to the problem in which the flow rate to the sink is a specified function of time and the distribution of piezometric head is unknown. The second solution corresponds to the inverse problem in which the piezometric head near the sink is a specified function of time and the flow rate to the sink is unknown. Coordinates of the free surface are determined as part of the solution in each case. The results can also be used to solve the analogous problem which occurs when an aquifer is recharged by a point source. (Knapp-USGS)
W70-05904

2G. Water in Soils

CHARACTERIZATION OF SOIL AERATION DURING SPRINKLER IRRIGATION,
North Dakota State Univ., Stillwater. Dept. of Agricultural Engineering; Michigan State Univ., East Lansing. Dept. of Agricultural Engineering; and Michigan State Univ., East Lansing. Dept. of Soil Science.
E. C. Stegman, A. E. Erickson, and E. H. Kidder.
American Society of Agricultural Engineers, Transactions, Vol 11, No 1, p 16-20, January-February, 1968. 6 fig, 2 tab, 20 ref.

Descriptors: *Sprinkler irrigation, *Aeration, *Infiltration, *Saturation, *Rates of Application, Soil moisture, Soil structure, Irrigation, Irrigation water, Irrigation efficiency, Irrigation practices, Oxygen, Pores.
Identifiers: *Soil aeration, *Pore space saturation, *Soil oxygen deficiency, *Oxygen diffusion rate, *Soil intake rate, Desorption.

Various investigators have concluded that there are beneficial effects when sprinkler irrigation systems apply water at rates well below the normal soil intake rate. Data suggest that decreased soil saturation reduces soil oxygen deficiency. Therefore a study was undertaken to develop a practical technique of evalutating aeration adequacy of soils during irrigation. It was first necessary to know the degree of pore space saturation which could be tolerated by a given soil. This could be realistically evaluated by combining oxygen diffusion rate measurements with a soil-moisture-retention test. Infiltration tests were conducted and it was clearly demonstrated that the rate of application influenced the degree of profile saturation. A feasible application rate existed such that degree of pore space saturation was not exceeded in the transmission zone of each of the soils tested. (Carr-Arizona)
W70-05591

HYDRAULIC DESCRIPTION OF RECESSION OF SHALLOW FLOW OVER A POROUS BED,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
D. L. Schreiber, and D. L. Bassett.
American Society of Agricultural Engineers, Transactions, Vol 10, No 1, p 54-56, 61, January-February 1967. 2 fig, 6 ref.

Descriptors: *Porosity, *Flow characteristics, *Mathematical models, *Recession curves, *Hydraulics, Flow, Flow measurement, Soil properties, Porous media, Computer models, Laboratory tests, Rational formula, Equations, Design criteria, Water delivery, Runoff, Infiltration, Flumes, Irrigation water, Open channel flow, Surface irrigation.
Identifiers: *Recession of flow, *Recession models, *Shallow flow.

A series of low-gradient, shallow flow studies is summarized. Purpose of the studies was to use a mathematical model to describe recession of flow over a porous bed when discharge onto the bed was stopped. The model consisted of two partial differential equations which were numerically integrated. Model validity was tested by comparing computer solutions with laboratory data for the same flow conditions. It appears that the model and its solution technique adequately describe recession of water over a porous bed. By combining the recession model with a previously-described advance model it should be possible to predict water behavior throughout an irrigation. This has tremendous value for design criteria for field surfaces and water delivery systems. (Carr-Arizona)
W70-05596

SPRINKLER INTENSITY AND SOIL TILTH,
Utah State Univ., Logan. Agricultural and Irrigation Engineering Dept.; and Utah Agricultural Experiment Station, Logan.
Jack Keller.
American Society of Agricultural Engineers, Transactions, Vol 13, No 1, p 118-125, January-February 1970. 10 fig, 4 tab, 16 ref.

Descriptors: *Sprinkler irrigation, *Rates of application, *Soil structure, *Soil mechanics, *Soil texture, Soil strength, Settlement (Structural), Bulk density, Mohr envelope, Time, Drainage, Soil water movement, Soil moisture, Moisture tension, Wetting, Drops (Fluids), Equations, Aggregates, Soil aggregates.
Identifiers: *Tilth, *Soil tilth.

Rate and duration of irrigation application have a definite effect on tilth of medium- and fine-textured soils. When combined with long duration and or poor soil drainage, high application rates can destroy soil tilth. Experimental results showed that the total amount of surface settling of each soil was a function of rate of application and initial bulk density of the sample. It was also found that amount of settling for a given sample and initial density was inversely proportional to minimum soil moisture tension during irrigation. A soil strength theory was proposed in which strength of loosely packed unstable soil to withstand consolidation forces is related to soil moisture tension during irrigation. (Carr-Arizona)
W70-05611

SOME EFFECTS OF SURFACE COVER GEOMETRY ON INFILTRATION RATE,
Auburn Univ., Ala.
J. L. Koon, J. G. Hendrick, and R. E. Hermanson.
Water Resources Research, Vol 6, No 1, p 246-253, February 1970. 8 p, 9 fig, 11 ref. OWRR Project A-005-ALA.

Descriptors: *Infiltration, *Permeability, *Laboratory tests, *Simulated rainfall, Model studies, Puddling, Ponding, Hydraulic models, Vegetation effects, Surface-groundwater relationships, Rainfall disposition, Impact (Rainfall).
Identifiers: Surface permeability, Soil cover effects.

Infiltration into the soil is regulated in part by sealing of the soil surface by raindrop impact. Soil surfaces protected from such impact maintained higher rates of infiltration than exposed soil surfaces. It was hypothesized that the cover particles protected the covered portion of the soil and prevented the reaction of raindrop impact on the soil state. The soil under the cover particles remained in the original state in which infiltration could occur. However, since the cover particles in this study were impervious, infiltration could not occur on the covered area but would occur along the available perimeter of the cover particles. Water would then move in both vertical and lateral directions. The effective lateral distance that the water moved after entry was defined as the effective width. To evaluate the effects of soil surface cover on the infiltration rate of soils exposed to raindrop impact, simulated rainfall was applied at a constant rate to one soil type in small plots with free drainage, and square and rectangular cover particles of varying sizes and percentages were used as surface cover. (Knapp-USGS)
W70-05636

POTABLE WATER AVAILABILITY ON LONG OCEANIC ISLANDS,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 02L.
W70-05646

DETERMINATION OF SOIL DENSITY AND WATER CONTENT BY FAST NEUTRONS AND GAMMA RAYS,
Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
J. C. Corey, A. R. Boulogne, and J. H. Horton.
Water Resources Research, Vol 6, No 1, p 223-229, February 1970. 7 p, 6 fig, 5 tab, 18 ref. USAEC Contract AT (07-2)-1.

Descriptors: *Nuclear moisture meters, *Gamma rays, *Soil moisture meters, *Instrumentation, Soil water, Bulk density, Moisture content.
Identifiers: Gamma attenuation meters, Neutron attenuation meters.

Sequential measurements of gamma and fast neutron attenuation were used for nondestructive determination of both soil density and water content of soil samples. Soils containing known amounts of water were packed into 22.5-cm diameter cylinders to a depth of 9 cm. Measurements were made of attenuation of fast neutrons and attenuation of gamma rays in a collimated beam. The attenuation was used to calculate the soil density and water content of these samples. The mean difference between the calculated and known water contents was 0.006 g/cc with a standard deviation of 0.010 g/cc; the mean difference for soil density was 0.010 g/cc with a standard deviation of 0.017 g/cc. Calculations based only on counting statistics show that an attenuation method using a combination of gamma and fast neutrons is better than a method using 2 gamma energies. (Knapp-USGS)
W70-05682

SOIL TEMPERATURE PROFILES DURING INFILTRATION AND REDISTRIBUTION OF COOL AND WARM IRRIGATION WATER,
California Univ., Davis.
P. J. Wierenga, R. M. Hagan, and D. R. Nielsen.

Water Resources Research, Vol 6, No 1, p 230-238, February 1970. 9 p, 6 fig, 2 tab, 14 ref.

Descriptors: *Soil temperature, *Infiltration, *Irrigation water, Mass transfer, Percolation, Heat transfer, Conduction, Convection, Evaporation, Soil-water-plant relationships.
Identifiers: Warm water irrigation.

Soil temperatures were measured in field profiles irrigated with cool and warm water and also measured in nonirrigated soil. Differences in soil temperature between plots after irrigation with cool (4.1 deg C) and warm (21.6 deg C) water, persisted longer at the lower soil depths. The time required after an irrigation for these differences to decline to less than 1 deg C was 14 hours at the 1-cm depth, 36 hours at the 10-cm depth, and 42 hours at the 20-cm depth. A numerical procedure developed for predicting changes in soil temperature through the soil profile after irrigation with cool and warm water gave good agreement between observed and calculated values in the subsoil but not in the surface soil. During infiltration heat transfer occurred mainly by mass movement, whereas after 10 hours soil heat transfer below 10 cm occurred mainly by conduction. (Knapp-USGS)
W70-05688

2H. Lakes

EUTROPHICATION TRENDS IN A CHAIN OF ARTIFICIAL LAKES IN MADRAS (INDIA),
Hydrological Research Station, Kilpauk (India).
A. Sreenivasan.
Environmental Health, Vol 11, p 392-401, 1969. 5 tab, 22 ref.

Descriptors: *Reservoirs, *Eutrophication, Nitrogen, Oxygen, Oxidation, Carbon dioxide, Alkalinity, Algae.
Identifiers: India, Methyl orange, Algal blooms.

Eutrophication of four consecutive artificial lakes--Ooty, Sandynulla, Pykara and Glenmorgan Forebay, India,--is discussed. Morphometric data, general conditions of the lakes for the years 1965-1967, the hydrological conditions of Glenmorgan Reservoir, and the quality of influent water into Ooty Lake and its outflow, are furnished. Due to damage of a waste disposal pipe, sewage has discharged into Ooty making it hyper-eutrophic. During 1962-1963, oxygen depletion below 2.0 was noted. During 1965-1966 steep gradients in free carbon dioxide and methyl orange alkalinity were noted and the organic nitrogen content reached 7.6-18.0 milligrams/liter. Ooty Lake plankton is dense year round with Microcystis aeruginosa occurring as a permanent bloom. Carbon dioxide accumulates in the bottom of Sandynulla Reservoir, but not as severely as in Ooty. Methyl orange alkalinity gradient was noted from surface to bottom during certain periods, more or less reflecting the influence of Ooty Lake. Oxygen depletion in the bottom was noted and organic nitrogen content was 2.1-15.0 ppm. Pykara Lake showed no change. Glenmorgan Forebay shows that it is not influenced by the waters from the other lakes. The removal of bottom sediments from Ooty is suggested to alleviate the problem. (Haskins-Wisconsin)
W70-05550

FACTORS INVOLVED IN DISPOSAL OF SEWAGE EFFLUENTS TO LAKES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Sanitary Chemistry.
For primary bibliographic entry see Field 05C.
W70-05565

FACTORS IN LAKE TYPOLOGY IN BRITISH COLUMBIA, CANADA,
P. A. Larkin, and T. G. Northcote.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 13, p 252-263, 1958. 5 fig, 1 tab, 14 ref.

Descriptors: *Lakes, *Classification, *Lake morphometry, Dissolved solids, Depth, Temperature, Fish, Benthic fauna, Standing crop, Regression analysis.
Identifiers: Lake typology, British Columbia (Canada).

The analysis of lake survey data from British Columbia have indicated that the content of total dissolved solids (TDS) serves as the best index of production. No significant relationship was established between other factors, including mean depth, and standing crops of aquatic organisms. It is impossible to apply typological classification of lakes of British Columbia because paradox is the rule rather than the exception. Bearing in mind that total dissolved solids summarizes aspects of both the substrate and climate as well as their interaction, it should be the best single indicator of a large portion of the physical environment. (Wilde-Wisconsin)
W70-05566

'TROPHIC' TYPOLOGY VERSUS BIOTIC TYPOLOGY, AS EXEMPLIFIED IN THE REGIONAL LIMNOLOGY OF NORTHERN SPAIN,
Ramon Margalef.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 13, p 339-349, 1958. 5 fig, 10 ref.

Descriptors: *Lakes, Lake morphology, Biota, Classification, Ecosystems, Plankton, Ecological distribution, Aquatic environments.
Identifiers: Regional limnology, Biotic typology, Spanish lakes, Baltic plankton, Caledonian plankton, Biocoenoses.

The population of every mass of water is considered as a biocoenose composed of a number of associations characterized by the frequency of occurrence of species having indicator value. The uniformity of composition of the terminal biocoenoses defines limnological regions. Over 2000 inventories, taken chiefly in the northern parts of Spain and Balearic Islands, delineated a number of limnological regions; their characteristics are outlined in tabular form. The relationships between trophic and biotic classificational approaches are questioned, as well as oligotrophic-entrophic ratings, biotic content of biotopes, and productive capacity of water basins, the problems which are too well known to students of terrestrial biocoenology. (Wilde-Wisconsin)
W70-05567

FAYETTEVILLE GREEN LAKE, NEW YORK. I. PHYSICAL AND CHEMICAL LIMNOLOGY,
Cornell Univ., Ithaca, N.Y. Div. of Biological Sciences; and Massachusetts Univ., Amherst. Dept. of Zoology.
G. J. Brunskill, and S. D. Ludlam.
Limnology and Oceanography, Vol 14, No 6, p 817-829, 1969. 9 fig, 7 tab, 40 ref.

Descriptors: *Lakes, *New York, *Meromixis, Bathymetry, Electrical conductance, Chemical stratification, Heat budget, Chemical analyses, Geology, History, Lake morphology, Chara, Chlorophyta, Cyanophyta, Gastropods, Climatology, Chemocline, Rainfall, Evaporation, Hydrologic budget, Oxidation-reduction potential, Photosynthetic bacteria, Water chemistry, Sulfur bacteria, Dissolved solids.
Identifiers: *Fayetteville Green Lake (NY), *Physical limnology, *Chemical limnology, Mixolimnion, Monimolimnion, Meromictic stability, Round Lake (NY), Replentishment time, Sonar, Drepanocladus aduncus, Shoreline development, Volume development, Bacterial plate, Mesothermy, Chlorobium phaeobacteroides, Chromatium vinosum, Dichothermy.

Fayetteville Green Lake, New York, is a meromictic (chemically stratified) lake in which monimolimnetic:mixolimnetic molar ratios of dissolved ions are greater than unity and maximal for species (iron, manganese, ammonia) influenced by redox potential. Such ratios for sodium, potassium, lithium, boron, bicarbonate, total carbon dioxide, chloride, and bromide are in range, 1.8-2.9; calcium, magnesium, and sulfate are enriched in monimolimnion by factors, 1.1-1.3. Based upon aerial photographic survey and 103 sonar transects, a new bathymetric map and table are presented, from which were derived estimates of following morphometric parameters: total drainage area, lake surface area, mixolimnetic volume, maximum depth, mean mixolimnetic depth, length, breadth, shoreline length, shoreline development, volume development, mean slope, depth of center of gravity (CG), depth of mixolimnetic CG. Consideration of these and estimated density differential between mixolimnion and monimolimnion (0.0006 grams/cubic centimeter) yields estimate of meromictic stability (1700 gram-centimeters/square centimeter). Thermal profiles by time and depth reveal strikingly persistent discontinuities in chemocline region, attributable to absorption of solar radiation by well developed 'plate' of photosynthetic bacteria primarily pigmented sulfur bacteria. Analyses for 20 ions, total dissolved solids, and electrical conductance are also presented. (See also W70-05614). (Eichhorn-Wisconsin)
W70-05613

FAYETTEVILLE GREEN LAKE, NEW YORK. II. PRECIPITATION AND SEDIMENTATION OF CALCITE IN A MEROMICTIC LAKE WITH LAMINATED SEDIMENTS,
Cornell Univ., Ithaca, N.Y. Div. of Biological Sciences.
G. J. Brunskill.
Limnology and Oceanography, Vol 14, No 6, p 830-847, 1969. 10 fig, 4 tab, 33 ref.

Descriptors: *Lakes, *New York, *Meromixis, *Sedimentation, *Chemical precipitation, *Calcite, Calcium, Hydrogen ion concentration, Carbonates, Gas chromatography, X-ray diffraction, Stokes' law, Sedimentation rates, Nitrogen, Sulfur, Phosphorus, Silicon, Iron, Carbon dioxide, Magnesium, Water chemistry, Chemical analyses, Temperature, Primary productivity, Algae, Photosynthesis, Chara, Daphnia, Organic matter.
Identifiers: *Fayetteville Green Lake (NY), *Laminated sediments, Titration alkalinity, Mixolimnion, Monimolimnion, Acid insoluble organic carbon, Acid insoluble nitrogen, Chemocline, EDTA titration techniques, Saturometry, Bacterial plate, Debye-Huckel equation, Activity coefficients, Carbonate equilibria, Crystal loads, Daphnia pulex, Physical chemistry.

Sediments of meromictic Fayetteville Green Lake, New York, are deposited annually in couplets of light and dark laminae, which probably reflect seasonal differential between precipitation rate of calcite and deposition rate of organic matter. Seasonal measurements of pH, temperature, calcium and titration alkalinity permitted calculation of calcium and carbonate activities. Based upon these data and thermodynamics of carbonate equilibria, detailed method of correcting for existing ion-pair interactions is described which yields estimates of calcite equilibrium activity product (K) and observed ion activity products (IAP) for calcium- and carbonate-ion. Ratio, IAP:K, estimates departure from calcite saturation, values exceeding unity indicating supersaturation. While internally generated calcite supersaturates water column throughout year, IAP:K at surface increases from winter values (2-4) to 6-8 during May-October, largely due to thermal effects on equilibria. Calcite precipitates massively during May-August, epilimnetic decreases in carbon dioxide indicating precipitation of 230 grams calcite/square meter per year upon bottom within 45-meter contour. Crystals settle 2-4 meters/day, consistent with rates calculated from Stokes' Law for observed particle sizes. Couplet production will probably continue so long as hydrologic and chemical budgets persist, meromictic stability exceeds wind work, and climate provides seasonal thermal differentials. (See also W70-05613). (Eichhorn-Wisconsin)
W70-05614

COMPREHENSIVE STUDY ON PROTECTION OF WATER RESOURCES OF LAKE TAHOE BASIN THROUGH CONTROLLED WASTE DISPOSAL,
Engineering-Science, Inc., Arcadia, Calif.; and Engineering-Science, Inc., Oakland, Calif.
P. H. McGauhey, Rolf Eliassen, Gerard Rohlich, Harvey F. Ludwig, and Erman A. Pearson.
Lake Tahoe Area Council, California, June 1963. 163 p, 93 fig, 107 tab, 105 ref, 9 append.

Descriptors: *Lakes, *Eutrophication, *Water resources, *Watershed management, *Waste disposal, California, Nevada, Planning, Hydrologic data, Land use, Climatology, Geology, Human population, Water utilization, Sewage treatment, Diversion, Distillation, Limnology, Design criteria, Costs, Analytical techniques, Data acquisition, Nutrients, Temperature, Phytoplankton, Chemical analysis, Water pollution control, Periphyton, Primary productivity.
Identifiers: *Lake Tahoe (Calif), *Lake Tahoe (Nev), Lake Tahoe Area Council, Geography, Plant nutrients.

The Lake Tahoe shore development for recreational purposes, one of the world's clearest lakes, has increased resident human population and subjected it to aggravated eutrophication influences. This detailed base line study was undertaken to determine resources of basin, evaluate its present status, and suggest programs to avoid further deterioration. Topical coverage of 16 chapters indicates its scope: introduction; geography of basin; climatology and hydrology; geology and hydrology; land use patterns; population forecasts; water consumption; existing sewerage facilities; quantity and characteristics of wastes; ground disposal studies; limnology and hydrography of Lake Tahoe, lacustrine eutrophication; methods of effluent disposal; design criteria and cost estimating bases; alternative treatment and disposal systems; summary and conclusions. Nine appendices include: list of figures; proposed compact terms for Tahoe basin; glossary of limnological terms; analytical methods used; temperature measurements; microplankton analyses; chemical characteristics; periphytic microorganisms; primary productivity measurements. These studies suggest that Lake Tahoe is very sensitive to additions of plant nutrients, and that additional nitrogen will be more damaging to its water quality than phosphorus. Ideally, control of eutrophication should be accomplished by diversion of effluents from the lake, or by distillation of secondary effluents--at great expense. (Eichhorn-Wisconsin)
W70-05615

A STUDY OF THE ONSET OF WHITECAPPING WITH INCREASED SURFACE WIND SPEEDS,
Northern Michigan Univ., Marquette. Dept. of Physics.
Edward C. Monahan.
Available from the Clearinghouse as AD-807 463, $3.00 in paper copy, $0.65 in microfiche. Feb, 67. 31 p.

Descriptors: *Waves, *Lakes, Lake breezes, *Wind, Velocity, Bubbles, Hydrography, Salinity, Photography, Water temperature.
Identifiers: Whitecap project, Lake Superior, Naugatuck vessel, Air water interactions, Tugs.

At present, the existence of abrupt changes in the physical character of the sea surface at certain wind speeds is indicated by measurements of certain surface related quantities while measurements of other such quantities indicate only smooth transitions in the nature of the sea surface. The data currently available on the occurrence of whitecaps, one measure of the character of the sea surface, are contradictory. It is the purpose of this study to investigate the onset of whitecapping as a function of wind speed, atmospheric stability, and water temperature in order to determine whether the concentration of whitecaps increases abruptly with wind speed, in which case it will be of interest to see how this critical wind speed varies with atmospheric stability and water temperature or whether whitecap concentration increases slowly with wind speed.
W70-05621

MODELING OF THE GREAT LAKES WATER SYSTEM,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Dale D. Meredith.
Water Resources Bulletin, Vol 6, No 1, p 55-64, January-February 1970. 10p, 2 fig, 1 tab, 33 ref. OWRR Project B-035-ILL.

Descriptors: *Great lakes, *Limnology, *Model studies, *Systems analysis, Mathematical mocels, Hydraulic models, Hydraulic similitude, Hydrology, Water balance, Hydrologic budget, Simulation analysis, Synthetic hydrology.
Identifiers: *Lake models.

Two predominate approaches to the modeling of the Great Lakes water system include physical models and mathematical models. The physical models have been of individual lakes whereas the mathematical models have varied from models of individual processes such as evaporation occurring in one portion of one lake to models which include all water quantity components for all given Great Lakes. The assumptions and limitations of the two approaches are presented along with the kinds of results to be expected from each type of modeling. Examples of previous modeling efforts are given to illustrate these assumptions, limitations, and results. Other areas requiring further research are outlined. (Knapp-USGS)
W70-05633

THE RELATION OF PHYTOPLANKTON PERIODICITY TO THE NATURE OF THE PHYSICOCHEMICAL ENVIRONMENT WITH SPECIAL REFERENCE TO PHOSPHORUS. I. MORPHOMETRICAL, PHYSICAL AND CHEMICAL CONDITIONS,
Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 02K.
W70-05647

THE RELATION OF PHYTOPLANKTON PERIODICITY TO THE NATURE OF THE PHYSICOCHEMICAL ENVIRONMENT WITH SPECIAL REFERENCE TO PHOSPHORUS. II. SEASONAL AND VERTICAL DISTRIBUTION OF THE PHYTOPLANKTON IN RELATION TO THE ENVIRONMENT,
Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 02K.
W70-05648

LATE-PLEISTOCENE CLIMATIC CHANGES INFERRED FROM THE STRATIGRAPHIC SEQUENCES OF JAPANESE LAKE SEDIMENTS,
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 02J.
W70-05654

THE RATIONALE OF PALEOLIMNOLOGY,
Indiana Univ., Bloomington. Dept. of Zoology.
David G. Frey.
Mitteilungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 7-18, 1969. 50 ref.

Descriptors: *Lakes, *Paleolimnology, Eutrophication, Sediments, Limnology, Sediment-water interfaces, Geomorphology, Chemical properties, Marl, Iron, Bacteria, Sedimentation, Pollen, Diatoms, Phytoplankton, Water chemistry, Diagenesis, Nutrients, Organic matter, Hydrology, Palynology, Stratigraphy, Oligotrophy, Bioindicators, Lake morphology, Climates, Michigan, Connecticut.
Identifiers: Current transport, Biological processes, Dy, Cladocera, Primary sedimentation, Secondary sedimentation, Lakes (Germany), Lakes (Ontario), Lakes (Switzerland), Lakes (England), Lakes (South America), Annual laminae, Laurentian Great Lakes, Old lakes, Evaporites, False bottom, Chronology, Fossil remains, Isotopes.

Lakes are sensitive integrators of chemical, physical, biological, and climatological processes occurring in them and influencing their basins. Among the synthesis of sciences constituting limnology, paleolimnologists must consider the added dimension of time in interpreting evidence bearing on lake history. Although laminate strata may reveal discrete temporal variations in sedimentation, the more usual condition is the blurring of sharp boundaries by retransport and secondary deposition. Accumulated lacustrine sediments are also modified by biological and chemical processes, and differential transport by currents and turbulence. A basic assumption of paleolimnology is that detailed study of many diverse characteristics of sediments will permit understanding of past climates, watershed conditions, water budgets, nutrient budgets, productivity, and the course of eutrophication. Organic compounds identified from lake sediments are numerous and diverse, and certain of them provide explicit information on the origin and productivity of specific organisms or groups or organisms. Morphological remains of a large variety of organisms (particularly diatoms, plant pollens, and cladocerans) constitute a fossil record which--however incomplete--permits meaningful interpretation of past conditions. Study of isotopes and isotope ratios in sediments also provides insights into lake metabolism history and microbial ecology. (Eichhorn-Wisconsin)
W70-05657

CULTURAL EUTROPHICATION WITH SPECIAL REFERENCE TO LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-05663

MUD LAKE, FLORIDA: ITS ALGAE AND ALKALINE BROWN WATER,
Geological Survey, Washington, D.C.; and Geological Survey, Ocala, Fla.
W. H. Bradley, and M. E. Beard.
Limnology and Oceanography, Vol 14, No 6, p 889-897, 1969. 4 fig, 1 tab, 9 ref.

Descriptors: *Lakes, *Florida, *Algae, *Alkaline water, Fishes, Water chemistry, Color, Chemical analyses, Hydrogen ion concentration, Iron, Manganese, Spectrophotometry, Calcium, Copper, Phosphates, Cobalt, Molybdenum, Temperature, Sulphates, Chlorides, Boron, Cyanophyta, Midges, Chlorophyta, Diatoms, Dystrophy, Physiological ecology, Magnesium, Sodium, Potassium, Fauna, Primary productivity.
Identifiers: *Mud Lake (Fla), *Brown water, Fecal pellets, Lake sediments, Zinc, Pistia, Specific conductance, Humic material, Macrophytes, Bacterial inhibitors, Eunotia, Coelosphaerium, Spirulina, Coccochloris, Anacystis, Schizothrix, Algal blooms, Sirogonium, Spirogyra, Stauroneis.

Mud Lake, Florida, is interesting because of its unusual biota, and its extensive sedimentary accumulation of algal ooze, which may represent a modern analogue of geological precursors of oil shale formations. Bottom layer of algal residues, about 1 meter thick, has been accumulating about 3000 years and constitute an energy sink, air-dried samples yielding 6600 calories/gram upon combustion. Ooze forms largely from blue-green algal (cyanophyte) remains in fecal pellets of midge larvae. This shallow lake (mean depth, less than 50 centimeters) has alkaline (pH, 7.7-10-2) water, seasonally colored brown, probably by humic materials originating from adjacent, frequently-flooded, mixed hardwood flora. Primary production derives from a benthic zone and a peripheral floating mat, incorporating flowering plants and a complex algal community. Benthos is dominated by diverse, bottom-dwelling flora of diatoms and cyanophytes, although erratic, massive blooms of

filamentous green algae occur, perhaps controlled by variations in phosphate concentrations, and optimal conditions of temperature and irradiance. True zooplankton and phytoplankton are nearly non-existent. A demonstrable antibacterial agent dissolved in lake's water probably functions to maintain the extremely sparse bacterial population there and at sedimental surface. Faunal inventory and monthly details of a water chemistry study are presented. (Eichorn-Wisconsin)
W70-05666

THE ROLE OF LARVAL CHIRONOMIDAE IN THE PRODUCTION OF LACUSTRINE COPROPEL IN MUD LAKE, MARION COUNTY, FLORIDA,
Indiana Univ., Bloomington. Dept. of Zoology; and Geological Survey, Washington, D.C.
A. J. Iovino, and W. H. Bradley.
Limnology and Oceanography, Vol 14, No 6, p 898-905, 1969. 9 fig, 1 tab, 15 ref.

Descriptors: *Lakes, *Florida, *Larvae, Sediments, Benthos, Wyoming, Oil shale, Water chemistry, Chlorophyta, Cyanophyta, Diatoms, Diagenesis, Radioactive dating, Animals, Biomass, Chlorella, Growth stages, Fishes, Predation, Inhibitors.
Identifiers: *Mud Lake (Fla), *Copropel, *Chironomidae, Algal ooze, Fossils, Feeding habits, Pistia, Procladius, Tanytarsus, Spirogyra, Sirogonium, Schizothrix, Coccochloris, Anacystis, Spirulina, Chironomine midges, Orthocladine midges, Tanypodine midges, Gloeocapsa, Chlorellin, Gosiute lakes, Vinta lakes.

Sediments of Mud Lake, Florida, are organic oozes, composed almost exclusively of cyanophyta cells (blue-green algae) contained within or growing upon fecal pellets of larval midges. Ooze is about 1 meter thick and, as determined from radiocarbon dating, has been accumulating some 3000 years. Compared with other north temperate lakes, midge populations here--primarily an undetermined species of Chironomus--are small (mean numbers for four dates during 12 months, 120-580/square meter). Small populations may result from fish predation; and reduced diversity, from environmental stresses imposed by shallow, alkaline, brown water. Lake has virtually no plankton; benthic flora comprises a diverse and complex assemblage of cyanophytes, fewer diatoms, and erratic winter blooms of green algae (Spirogyra, Sirogonium). Laboratory experiments with midges demonstrated that: increased numbers of fecal pellets are produced when algal cells are in higher concentrations; pellets remain coherent and durable when larvae feed on cyanophytes but not on green algae; larvae revert from filter-feeding to grazing on fecal pellets when suspended cyanophyte cells become scarce. Presence of fecal pellets and remains of immature chironomids in some oil shales suggest relationship between copropel, as formed in Mud Lake, and Eocene precursors of Green River Formation oil shale. (Eichhorn-Wisconsin)
W70-05667

HYDRODYNAMIC INSTABILITY OF MISCIBLE FLUIDS IN A VERTICAL POROUS COLUMN,
Guelph Univ. (Ontario).
For primary bibliographic entry see Field 02F.
W70-05677

A METHODOLOGY FOR SELECTING AMONG WATER QUALITY ALTERNATIVES,
Florida Univ., Gainesville. Dept. of Environmental Engineering; and North Carolina Univ., Chaper Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 05G.
W70-05703

AQUATIC SCIENCES IN THE GREAT LAKES AREA.
For primary bibliographic entry see Field 09D.
W70-05738

WATERBLOOM FORMING BLUE-GREEN ALGAE IN NORWAY AND THEIR IMPORTANCE IN THE STUDY OF THE INFLUENCE OF CULTURE ON THE WATER RESOURCES (IN NORWEGIAN),
Norsk Institutt for Vannforskning, Blindern.
For primary bibliographic entry see Field 05C.
W70-05751

FAYETTEVILLE GREEN LAKE, NEW YORK. III. THE LAMINATED SEDIMENTS,
Massachusetts Univ., Amherst. Dept. of Zoology.
For primary bibliographic entry see Field 02J.
W70-05753

THE EFFECTS OF ARTIFICIAL ENRICHMENT OF A LAKE,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Fisheries and Oceanography.
A. Weatherley, and A. G. Nicholls.
Australian Journal Marine Freshwater Research, Vol 6, No 3, p 443-470, 1955. 10 fig, 6 tab, 34 ref, 2 plates, appendix.

Descriptors: *Lakes, Mud, Phytoplankton, Zooplankton, Growth rates, Fish, Phosphorus, Temperature, Chemical analysis, Trout, Oxygen, Hydrogen ion concentration, Alkalinity, Silts, Iron, Nitrogen, Organic matter, Amphipoda, Copepods, Diptera, Fertilizers, Aquatic plants.
Identifiers: *Artificial enrichment, Lake Dobson (Australia), Myriophyllym elatinoides, Isoetes, Lake Fenton (Australia), Pulmonata, Eulamellibranchia, Chironomidae, Plecoptera, Calanoid, Cyclopoids, Bottom fauna.

A Tasmanian highland lake of low natural productivity was enriched by addition of a mixture of chemicals. The first application, to the mud, stimulated the existing stunted aquatic vegetation to produce a prolifivc growth; a latter application, broadcast over a portion of the lake, additionally increased phytoplankton and zooplankton. Concurrent with the plant growth was a marked increase in the total numbers of epiphytic fauna. Fish living in the lake at the time of enrichment showed a marked increase in growth rate, and others released later showed a similar response. It is tentatively concluded that phosphorus was the element responsible for the stimulus to the growth of plants and plankton. Phosphorus, of acknowledged importance in plant nutrition, is the element which bears the most striking relationship to where the plants came from and their mode of growth. It now appears unlikely that nitrogen deficiency might have been one of the limiting factors to plant development. The chief effect of adding fertilizer has been to induce a flourishing growth of aquatic plants. It is shown that an unproductive lake of this type can, by suitable enrichment, be rendered capable of carrying a fish stock. (Jones-Wisconsin)
W70-05754

PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE WATER,
Indiana Univ., Bloomington.
For primary bibliographic entry see Field 05C.
W70-05755

THE DISTRIBUTION AND PERIODICITY OF THE PHYTOPLANKTON OF THREE CEYLON LAKES,
London Univ. (England).
E. C. T. Holsinger.
Hydrobiologie, Vol 7, p 25-35, 1955. 3 fig, 1 tab, 10 ref.

Descriptors: *Phytoplankton, *Distribution, *Lakes, Cyanophyta, Diatoms, Temperature, Productivity, Rainfall, Solar radiation, Water circulation, Organic matter, Soil texture, Mountains, Sampling, Nitrogen, Conductivity, Calcium, Hydrogen ion concentration, Water pollution, Chrysophyta.
Identifiers: *Periodicity, *Ceylon, Oscillatoria, Lyngbya, Microcystis aeruginosa, Desmids, Beira Lake (Ceylon), Nuwara Wewa Tank (Ceylon), Gregory Lake (Ceylon), Melosira ambigua, Melosira granulata, Arthrospira platensis, Chlorococcales, Staurastrum.

The phytoplankton of three Ceylon lakes, two situated in the warm lowlands and one in the mountains, was investigated. Certain similarities and differences regarding growth, distribution and periodicity of the plankton algae are related to environmental conditions. The lowland lakes are dominated by Cyanophyta which form 95% and 87% of the phytoplankton respectively, while in the mountain lake, which is temperate rather than tropical, diatoms for 65% of the phytoplankton. One of the lowland lakes lying in the center of densely populated city of Colombo has an algal productivity 2-1/2 times as great as the other, situated in a vast area of uncultivated land. The mountain lake, surrounded by cultivated hills, occupies an intermediate position between the low country lakes in regard to productivity. The environmental factors affecting algal growth, distribution and periodicity are temperature, rainfall, sunshine, movement of the water, amount of influx of organic matter and nature of the surrounding soil. In assessing the effect of rainfall, consideration has been given not only to the total precipitation, but also to its intensity and the occurrence of periods of drought. (Jones-Wisconsin)
W70-05756

FAYETTEVILLE GREEN LAKE, NEW YORK. IV. INTERSTITIAL WATER CHEMISTRY OF THE SEDIMENTS,
Cornell Univ., Ithaca, N.Y. Div. of Biological Sciences; and Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 02J.
W70-05757

STUDIES ON THE SEDIMENTARY, ACID-SOLUBLE ORGANIC MATTER FROM LAKE MAGGIORE (NORTH ITALY). I. HETEROGENEITY AND CHEMICAL PROPERTIES OF A FRACTION PRECIPITATED BY BARIUM IONS,
Istituto Italiano di Idrobiologia, Pallanza.
For primary bibliographic entry see Field 02J.
W70-05759

FAYETTEVILLE GREEN LAKE, NEW YORK. V. STUDIES OF PRIMARY PRODUCTION AND ZOOPLANKTON IN A MEROMICTIC MARL LAKE,
Cornell Univ., Ithaca, N.Y. Div. of Biological Sciences.
D. A. Culver, and G. J. Brunskill.
Limnology and Oceanography, Vol 14, No 6, p 862-873, 1969. 7 fig, 4 tab, 26 ref.

Descriptors: *Lakes, *New York, *Meromixis, *Primary productivity, *Zooplankton, Sulfur bacteria, Diel migration, Carbon dioxide, Hydrogen ion concentration, Phosphates, Nitrates, Daphnia, Silica, Thermal stratification, Sulfides, Ammonium compounds, Oxidation reduction potential, Dissolved oxygen, Chemical analysis, Organic matter, Algae, Iron, Hydrogen sulfide, Cyanophyta, Chlorophyta, Light penetration.
Identifiers: *Fayetteville Green Lake (NY), *Marl lakes, Chlorobium, Filinia, Monimolimnion, Chemocline, Mixolimnion, Radiocarbon uptake techniques, Bacterial plate, Bacterial pigments, Diaptomus, Epischura, Orthocyclops, Keratella, Polyarthra, Conochilus, Pycnocline, Photolithotrophic bacteria, Desulfovibrio, Mesothermy, Melosira, Synedra, Rhodomonas, Cyclotella, Chromatium.

Meromixis of Fayetteville Green Lake, New York, influences its trophic structure in the sense that bacterial primary production resembles total primary production in eutrophic lakes, while algal production is more oligotrophic. Seven determinations of radiocarbon uptake in light and dark bottles were made between October 1966 and the following July. Annual primary production was estimated at 290 grams carbon/square meter, of which approximately 83% was bacterial, primarily due to well developed plate of photosynthetic sulfur oxidizers in the chemocline (18-20 meters). Algal productivity may be limited by unfavorable ratio, monovalent cations:divalent cations, which has value of 0.06 in this lake, whereas higher ratios, in range 2-30, are considered optimal. Zooplanktonic biomass was dominated by copepods. Dense concentrations of zooplankters occur near the bacterial plate, where they probably feed on bacteria or on mixolimnetically produced seston, which tends to accumulate in the chemocline. Quantitative sampling of zooplankton with Clarke-Bumpus sampler yielded evidence for diel migrations of many species. (Eichhorn-Wisconsin)
W70-05760

THE EUTROPHICATION OF LAKES AND THE RADICAL CHANGE OF THEIR MATERIAL CONTENT (IN GERMAN),
For primary bibliographic entry see Field 05C.
W70-05761

EFFECTS OF RESERVOIR IMPOUNDMENT ON WATER QUALITY,
Corps of Engineers, Savannah, Ga. Special Programs Section.
For primary bibliographic entry see Field 05C.
W70-05883

2I. Water in Plants

UPTAKE OF ORGANIC SUBSTANCES FROM SOIL ORGANIC MATTER BY PLANT AND THEIR INFLUENCE ON METABOLISM,
Institut fuer Biochemie des Bodens der Forschungsanstalt fuer Landwirtschaft, Brunswick (West Germany).
W. Flaig.
Pontificiae Academiae Scientarum Scripta Varia, Vol 32, p 1-48, 1968. 12 fig, 2 tab, 112 ref.

Descriptors: *Organic compounds, *Plant growth, *Metabolism, *Phenols, Lignin, Degradation, Synthesis, Carbon dioxide, Plant physiology, Plant growth substances, Climates, Iron, Phosphorus, Potassium.
Identifiers: *Increased uptake, *Sugar metabolism, Indol-acetic acids, Antibiotics, Citric acid cycle, Endoxidation, Transamination, Sauerbeck-Fuhr-Harms experimental designs.

The 'humus effect' is not confined to physical and chemical properties of soils, but is also important in biochemical processes of plants. This is particularly true of phenols and their oxidation products, polymers formed in degradation of lignin, and indol-acetic acids. The phenolic compounds are largely transformed into glucose esters and glucosides inside the plant; some of these are decarboxylated. Added amino-acids undergo transformations. The uptake and transport of physiologically active organic substances are influenced by environmental conditions and require energy in amounts comparable to those involved in uptake and transfer of nutrient ions. The effect of organic substances on the growth of plants may be better explained by uncoupling of oxidative phosphorylation than by their influence on synthesis of nucleic acids and proteins. The favorable influence of physiologically active organics attains particular importance under unfavorable climatic conditions. The report probes into an old mystery of humus and indirectly stresses the importance of rhizospheric microorganisms. (Wilde-Wisconsin)
W70-05555

CONTINUOUS MONITORING OF SOIL MOISTURE TENSION PROFILES,
Agricultural Research Service, Fresno, Calif. Soil and Water Conservation Research Div.; and Nevada Bureau of Mines, Reno. Desert Research Inst.
W. C. Bianchi, and Rhys Tovey.
American Society of Agricultural Engineers, Transactions, Vol 11, No 3, p 441-443, 447, May-June 1968. 10 fig, 6 ref.

Descriptors: *Moisture tension, *Monitoring, *Measurement, *Tensiometers, *Equipment, Irrigation, Tension, Soil moisture, Soil water, Strain gages, Lysimeters, Manometers, Instrumentation, Calibrations, On-site data collections, Pressure, Electrical equipment.
Identifiers: *Soil moisture tension, *Pressure transducers, *Transducers, Scanning systems.

Although conventional gage or manometer-type tensiometers cannot be used for long-term measurement of changes in soil moisture tension, pressure transducers can be effectively employed. Minimum-cost hydraulic scanning and electronic scanning systems were studied and soil moisture tensions under irrigated alfalfa were measured. Multipoint electronic scanning of many individual strain-gage tensiometers yielded reliable field data throughout the growing season. In order to attribute soil moisture tension changes directly to changes in evapotranspiration, it is necessary to thermally isolate the measurement system. Zero shift of the transducers is the most important limitation of the pressure transducer system. External means of zero calibration are required, such as raising or creating a water table above transducers in lysimeters. (Carr-Arizona)
W70-05592

THE EFFECT OF WATER STRESS ON TRANSLOCATION IN RELATION TO PHOTOSYNTHESIS AND GROWTH: I. EFFECT DURING GRAIN DEVELOPMENT IN WHEAT,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
I. F. Wardlaw.
Australian Journal of Biological Sciences, Vol 20, No 1, p 25-39, February 1967. 4 fig, 6 tab, 49 ref.

Descriptors: *Moisture stress, *Translocation, *Photosynthesis, *Plant growth, *Wheat, Leaves, Stomata, Crop response, Wilting, Moisture deficit, Turgidity, Light, Plant physiology, Velocity, Growth stages, Carbon dioxide.
Identifiers: *Carbon 14, *Assimilates, *Grain growth.

Wheat plants were placed under water stress 15-20 days after anthesis. During the stress period rate of photosynthesis and translocation of assimilates were studied. There was progressive reduction in photosynthesis rate after the onset of wilting and rate of wilted leaves was lower than that of turgid leaves. Several days of leaf wilting did not effect grain growth, as assimilates were redistributed from the lower parts of the plant to the grain. Stress had little effect on the velocity of translocation, but movement of assimilates into conducting tissues was prolonged in wilted leaves. It would appear from these results that water stress acts directly on the leaf, rather than indirectly through growth or sugar movement. (Carr-Arizona)
W70-05603

CROP YIELD RESPONSE TO NONUNIFORM APPLICATION OF IRRIGATION WATER,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-05604

VEGETATIONAL MAP AND COMMUNITY STRUCTURE OF A WEST CENTRAL KANSAS PRAIRIE,
Fort Hays Kansas State Coll., Hays. Div. of Biological Sciences.
Rodney K. Heitschmidt, G. K. Hulett, and G. W. Tomanek.
The Southwestern Naturalist, Vol 14, No 3, p 337-350, January 15, 1970. 2 fig, 3 tab, 22 ref.

Descriptors: *Soil moisture, *Grasslands, *Plant groupings, *Mapping, *Kansas, Semiarid climates, Soils, Soil types, Topography, Maps, Wheatgrasses, Vegetation, Plant populations, Soil moisture, Soil-water-plant relationships, Soil profiles, Sampling, Plant populations.
Identifiers: *Vegetational communities, *Soil moisture gradient.

A study was undertaken to outline cartographically vegetational communities on a 176-acre prairie in western Kansas. Vegetational structure, topographic position, and underlying soils were used to characterize the seven recognized communities. These communities were classified as: Buchloe-Bouteloua, Buchloe-Bouteloua-Agropyron, Bouteloua, Bouteloua-Andopogon, Andopogon gerardi, Andopogon scoparius, and Kochia. Soil moisture gradient, resulting from combined effects of topography and soils, was found to be the primary determinant of the communities. (Carr-Arizona)
W70-05612

STOMATAL CLOSURE IN CONIFER SEEDLINGS IN RESPONSE TO LEAF MOISTURE STRESS,
Forest Service (USDA), Wenatchee, Wash. Pacific Northwest Forest and Range Experiment Station.
William Lopushinsky.
Botanical Gazette, Vol 130, No 4, p 258-263, 1969.

Descriptors: *Stomata, *Moisture stress, *Transpiration, *Transpiration control, Conifers, Soil moisture, Soil-water-plant relationships, Ponderosa pine trees, Lodgepole pine trees, Douglas-fir trees, Grand fir trees.
Identifiers: Engelmann spruce trees.

Water content and water stress of foliage at stomatal closure were determined for 3-year-old seedlings of ponderosa pine, lodgepole pine, grand fir, Douglas-fir, and Engelmann spruce. Stomatal behavior during increasing soil drought was interpreted from transpiration trends of seedlings kept under controlled conditions, and degree of stomatal opening was determined with a pressure infiltration technique. At stomatal closure, needle water contents ranged from 122% to 162% and were lowest in Engelmann spruce and Douglas-fir, intermediate in the pines, and highest in grand fir. Needle relative turgidity ranged from 81% to 86% with little difference between species, and leaf moisture stress ranged from 14 to 25 atmospheres. The pines and spruce had the lowest stress, indicating that the stomata of these species were more sensitive to increasing leaf moisture stress than those of the firs. Transpiration-decline curves obtained with excised twigs indicated that stomatal closure occurred more rapidly in the pines and spruce than in the firs. (Lopushinsky-USFS)
W70-05617

AN ANALYSIS OF THROUGHFALL AND STEMFLOW IN MIXED OAK STANDS,
Rhode Island Univ., Kingston; and Essex Agricultural and Technical Inst., Hathorne, Mass.
James H. Brown, Jr., and Albert C. Barker, Jr.
Water Resources Research, Vol 6, No 1, p 316-323, February 1970. 8 p, 4 tab, 11 ref. OWRR Project A-001-RI.

Descriptors: *Interception, *Stemflow, *Throughfall, *Oak trees, Statistical methods, Canopy, Regression analysis, Precipitation (Atmospheric), Vegetation effects, Rainfall-runoff relationships.
Identifiers: Greenwich (R.I.).

Net rainfall was studied under immature stands of mixed oak in southern New England. Throughfall did not differ significantly between stands. Stemflow was measured from all trees on one-fortieth-

acre plots. Although yields varied greatly between plots, plot sampling of stemflow within 15% error tolerance was considered practical in most mixed oak stands. Both average dbh of dominant and codominant trees on stemflow plots and plot basal area showed high positive correlations with stemflow. Analysis of individual stems showed species and dbh highly correlated with stemflow. Black oaks yielded more stemflow than white oaks. The only storm characteristic significantly correlated with stemflow was storm size. Stemflow was greater during the dormant season. (Knapp-USGS)
W70-05634

EFFECTS OF KAOLINITE AS A REFLECTIVE ANTITRANSPIRANT ON LEAF TEMPERATURE, TRANSPIRATION, PHOTOSYNTHESIS, AND WATER-USE EFFICIENCY,
California Univ., Davis.
For primary bibliographic entry see Field 2D.
W70-05635

2J. Erosion and Sedimentation

FAYETTEVILLE GREEN LAKE, NEW YORK. II. PRECIPITATION AND SEDIMENTATION OF CALCITE IN A MEROMICTIC LAKE WITH LAMINATED SEDIMENTS,
Cornell Univ., Ithaca, N.Y. Div. of Biological Sciences.
For primary bibliographic entry see Field 02H.
W70-05614

THE STRENGTH AND CREEP OF FROZEN SOILS AND CALCULATIONS FOR ICE-SOIL RETAINING STRUCTURES,
Cold Regions Research and Engineering Lab., Hanover, N.H.
S. S. Vyalov, V. G. Gmoschinskii, S. E. Gorodetski, V. G. Grigorieva, and Yu K. Zaretski.
Available from the Clearinghouse as AD-484 093, $3.00 in paper copy, $0.65 in microfiche. CREL-Trans-76, Sep 65. 324 p.

Descriptors: *Frozen soils, *Soil strength, Walls, *Rheology, Deformation, Stress, Creep, Test procedures, Ice, Particle size.
Identifiers: Soil texture, Frost, Artifically frozen soils, USSR.

Since frozen soils are relatively strong and watertight, they may be used successfully as materials for various types of engineering construction. For example, artifically frozen soils may be used as retaining structures during mining and under complex hydrogeological conditions for sinking open-shafts. When plans and static calculations are being made for constructions on frozen soils, it is necessary to take into consideration the specific properties of such soils. The strength and deformation properties of frozen soils depend essentially upon soil-temperature, soil-composition, and soil-texture (grain-size distribution, moisture content, ice content, frost texture, etc.). Furthermore, the stress-deformation characteristics of frozen soils depend to a very large degree upon the time factor. Since ice and unfrozen water are present, the soils possess clearly defined rheological properties, such as increasing deformation with time (creep), and relaxation and reduction of strength. This book is devoted to the study of the rheological properties of frozen soils and to the development of methods for calculating creep and long-term strength of retaining structures made from artifically frozen soils.
W70-05625

SUBMARINE TOPOGRAPHY AND SEDIMENTATION IN THE VICINITY OF MUGU SUBMARINE CANYON, CALIFORNIA,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
D. L. Inman.
Available from the Clearinghouse as AD-699 396, $3.00 in paper copy, $0.65 in microfiche. Beach Erosion Bd Rept no. TM-19 July, 1950, 50 p.

Descriptors: *Beaches, *Beach erosion, *Oceanography, Sedimentation, Sampling, Ocean currents, Sands.
Identifiers: Mugu Submarine Canyon, Ocean ridges.

Mugu Submarine Canyon resembles the subaerially eroded canyons inland except that the two branches at its head are somewhat unusual in having an isolated ridge protruding from the floor of each branch and parallel to the canyon axis. Cores indicate that there are hard rock outcrops at several points on the floor along the deeper portions of the canyon. The maximum gradient of the canyon occurs at its two heads and may represent the maximum angle of repose of recent fill. There are indications that the heads and sides of the submarine canyon are relatively unstable as compared to the more gently sloping shelf areas on either side of the canyon. The sediments on the shelf areas adjacent to the canyon show a somewhat systematic variation in type; however, the distribution of sediments from the floor and sides of the canyon is complex and not a function of depth. Analysis of the samples shows that the upper canyon sediments are poorly sorted and have an asymmetrical size distribution which differs from the well sorted and more symmetrical shelf sediments.
W70-05628

LATE-PLEISTOCENE CLIMATIC CHANGES INFERRED FROM THE STRATIGRAPHIC SEQUENCES OF JAPANESE LAKE SEDIMENTS,
Kyoto Univ., Otsu (Japan). Otsu Hydrobiological Station.
S. Horie.
Means of Correlation of Quaternary Successions, Vol 8, Proceeding 7, Congress International Association for Quaternary Research, University of Utah Press, Salt Lake City, p 311-324, 1968. 5 fig, 6 ref.

Descriptors: *Lakes, *Sediments, Stratigraphy, Climates, Glaciation, Eutrophication, Biomass, Nitrogen, Calcium carbonate.
Identifiers: Japanese lakes, Pleistocene, Ancient lakes, Ignition loss, Sea levels, Japanese coasts, Pre-Holocene lakes, Trophic stages, Yogo-ko (Japan), Kizaki-ko (Japan), Biwa-ko (Japan), Japan.

Cores of 2 to 10 meters in length were obtained with a Livingstone borer from the bottoms of Japanese lakes Yogo-ko, Kizaki-ko, and Biwa-ko. The latter is the largest Japanese lake and together with Lake Baikal, is the oldest lake of the world, aged about 10 million years. The cores, subjected to various analyses, revealed the periods of decreased precipitation during glacial interstadials and corresponding trophic-stage fluctuations. Since Wisconsin glaciation, sea level rose to a peak about 4,000 years ago, then dropped slightly, and finally rose to the present level. In spite of the marked instability of the earth's crust of the Japanese Islands, climatic changes appear to be more effective than crustal deformation as factors influencing lake trophy. The boundary between oligotrophy and mesotrophy or eutrophy was tentatively established at 0.25% of nitrogen in the mud on oven-dry basis. (Wilde-Wisconsin)
W70-05654

ACCUMULATION OF RADIONUCLIDES IN BED SEDIMENTS OF THE COLUMBIA RIVER BETWEEN THE HANFORD REACTORS AND McNARY DAM,
Battelle Memorial Inst., Richland, Wash., and Geological Survey. Portland, Oreg.
For primary bibliographic entry see Field 05B.
W70-05675

SEDIMENT IN RELATION TO WATER QUALITY,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
For primary bibliographic entry see Field 05B.
W70-05705

PROFILES OF A REACH OF THE SAN JOAQUIN RIVER BELOW FRIANT DAM, FRESNO AND MADERA COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02E.
W70-05725

THE ROLE OF SECONDARY CURRENTS IN HYDRAULICS,
Pittsburgh Univ., Pa. School of Engineering.
For primary bibliographic entry see Field 02E.
W70-05743

SECONDARY CURRENTS IN THE NEWCASTLE HARBOUR SILTATION INVESTIGATION,
Department of Public Works, Sydney (Australia). Hydraulic Lab.; and Department of Public Works, Sydney (Australia). Maritime Service Board.
Arthur H. Lucas, and Peter B. Stone.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A56, p 456-464, 1967. 9 p, 8 fig, 3 tab, 2 ref.

Descriptors: *Density currents, *Turbidity currents, *Silting, *Harbors, Currents (Water), Water circulation, Channel morphology, Sediment load, Flocculation, Deposition (Sediments), Suspended load.
Identifiers: *Secondary currents, *Australia, Newcastle Harbor.

Secondary currents in the form of salinity density currents have a significant effect on the hydraulics and siltation of a harbor. As river fresh flow increases, these currents cause a considerable variation in the tidal exchange of basins off the main estuary of the Hunter River, Newcastle, N.S.W., Australia. The system of orders of aggregation of silts developed by Krone correlated well with the performance of silts from the harbor. This gave confidence to an analysis of siltation prediction which took into account the secondary currents caused by density differences in the basins. A comparison was made with an analysis in which no secondary currents were considered. The work was undertaken in an investigation into the siltation of Newcastle Harbor. The problem was the high and increasing cost of maintenance dredging in the shipping channels. To assist in understanding the harbor and to study proposed schemes a relationship was established between tidal discharge and the cross-sectional area of channels not requiring dredging. The steelworks Channel in the South Arm and Wickham Basin both had tidal discharges well below that required for a maintenance free condition. The investigation then attempted to evaluate the rate of siltation for various schemes with non-equilibrium conditions. For these conditions the secondary density currents, which cause increased tidal exchange, considerably influence the siltation. An evaluation is given of the changes in hydraulics and siltation brought about by a complete blockage of the South Arm upstream of the shipping channels. (Knapp-USGS)
W70-05746

THE MECHANICS OF DUNE FORMATION IN ERODIBLE-BED CHANNELS,
Public Works Research Inst., Tokyo (Japan).
Akihiko Tsuchiya, and Katsuyoshi Ishizaki.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A59, p 479-486, 1967. 8 p, 7 fig, 4 ref.

Descriptors: *Dunes, *Bed load, *Alluvial channels, Sediment transport, Sand waves, Waves (Water), Turbulence, Fluid mechanics, Mathematical studies, Model studies.
Identifiers: Erodible-bed channels.

Bed configuration in erodible bed channels varies according to the hydraulic conditions of flow and bed material. The mechanics of dune formation was analyzed by introducing the interaction between surface waves and sand waves on the bed. The compounding of several waves which are generated simultaneously in a channel and have different wave lengths could well illustrate the mechanics of dune formation. The height of dune was also analyzed in connection with bed load transportation. (Knapp-USGS)
W70-05748

THE STABLE PROFILES OF THE CURVED OPEN CHANNEL BEDS,
Public Works Research Inst., Tokyo (Japan).
Kyozo Suga.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A60, p 487-495, 1967. 9 p, 6 fig, 1 tab.

Descriptors: *Open channel flow, *Meanders, *Alluvial channels, Mathematical studies, Model studies, Sediment transport, Bed load, Equilibrium, Channel morphology.
Identifiers: Open-channel bend hydraulics.

Stable lateral bed profiles of continuous curved open channels, both in dynamic and in static equilibrium, were analyzed theoretically by some assumptions on the velocity and bed material load distributions in the bends, and the analyses were verified experimentally. Some characteristics of the stable plane profiles of the beds and of the flow in these states were also clarified by experiments of 33 cases using 11 kinds of curved channel. (Knapp-USGS)
W70-05749

FAYETTEVILLE GREEN LAKE, NEW YORK. III. THE LAMINATED SEDIMENTS,
Massachusetts Univ., Amherst. Dept. of Zoology.
Stuart D. Ludlam.
Limnology and Oceanography, Vol 14, No 6, p 848-857, 1969. 1 fig, 4 tab, 22 ref.

Descriptors: *Lakes, *New York, *Meromixis, *Sediments, Varves, Density currents, Sedimentation rates, Calcium carbonate, Analytical techniques, Organic matter, Snails, Marl, Erosion, Cores, Clays, Littoral, Calcite, Slopes, Turbidity currents.
Identifiers: *Fayetteville Green Lake (NY), *Laminated sediments, Bioherms, Chemocline, Manlius (NY), Dewitt (NY), Round Lake (NY), Jamesville Green Lake (NY), Turbites, Coupled laminae, Clastic matter, Surficial sediments, Birge-Ekman dredge, Mackereth cores, Varved beds.

As studied from dredge (Birge-Ekman) samples and cores (Mackereth), surficial sediments of meromictic (chemically stratified) Fayetteville Green Lake, New York, consist of alternating horizons of coupled laminae and unlaminated beds. Couplets, consisting of a basal pale layer and an overlying darker layer, are annually deposited varves, sedimentation of which is apparently controlled by seasonally differentiated rates of sedimentation of precipitated calcite and organic matter. Weight of sediment deposited per unit area in couplets yields deposition rates (in grams/square centimeter per year) of 0.07 for dry sediment and 0.05 for calcium carbonate. In more shallow, neck-like region of lake, couplets are sedimented only at depths greater than the chemocline. Unlaminated beds, massive and frequently graded in structure, result from deposition by density currents of heterogeneously derived materials which often originate in the littoral zone. Such sediments (turbidites) represent 40-65% of total sedimentary accumulation at depths greater than 25 meters. (Eichhorn-Wisconsin)
W70-05753

FAYETTEVILLE GREEN LAKE, NEW YORK. IV. INTERSTITIAL WATER CHEMISTRY OF THE SEDIMENTS,
Cornell Univ., Ithaca, N.Y. Div. of Biological Sciences; and Florida State Univ., Tallahassee. Dept. of Oceanography.
Gregg J. Brunskill, and Robert C. Harriss.
Limnology and Oceanography, Vol 14, No 6, p 858-861, 1969. 1 fig, 2 tab, 5 ref.

Descriptors: *Lakes, *New York, *Meromixis, *Water chemistry, *Connate water, *Sediments, Salinity, Chemical analysis, Analytical techniques, Groundwater, Cores, Oxidation-reduction potential, Hydrogen ion concentration, Sodium, Magnesium, Calcium, Colorimetry, Silica, Chlorides, Fluorides, Calcite.
Identifiers: *Fayetteville Green Lake (NY), Chemocline, Mixolimnion, Diatom frustules, Monimolimnion, Aluminosilicate minerals, Ratio (Chloride:Sodium), Saline springs, Salina Formation halite beds, Strontium, Aragonite, Atomic absorption spectrophotometry, Specific ion electrodes, Bromides, Mineral-water equilibria.

Analyses of water expressed from sediment cores from Fayetteville Green Lake, New York, indicate that inflow of saline groundwater contributed importantly to origin of meromixis. Such influx, probably originating from underlying halite formations, undoubtedly helps maintain chemical stratification of lake. Interstitial water was analyzed for sodium, magnesium, strontium, and calcium by atomic absorption spectrophotometry; for silica by molybdate colorimetry; and for chloride, fluoride, and bromide with solid-state specific ion electrodes. In core taken from deep basin of lake, composition of interstitial water increases in sodium, magnesium, strontium, calcium, chloride, and bromide with depth. Similarly, small increases of the ratio, chloride:sodium, occur below sediment-water interface. Two cores from shallow areas contain water with composition similar to that of overlying lake water except for slight enrichment in bromide and silicate. Water of core from intermediate depth is influenced by chemocline, and analyses suggest that lateral migration and mixing of mixolimnetic and monimolimnetic water occurs in this region. Compared with overlying water, interstitial water is enriched in silica by factors in range, 1.1-14.4. Variations in silica are not consistently related to sediment texture or depth, and enrichment may arise from dissolution of diatom frustules or aluminosilicate minerals. (Eichhorn-Wisconsin)
W70-05757

STUDIES ON THE SEDIMENTARY, ACID-SOLUBLE ORGANIC MATTER FROM LAKE MAGGIORE (NORTH ITALY). I. HETEROGENEITY AND CHEMICAL PROPERTIES OF A FRACTION PRECIPITATED BY BARIUM IONS,
Istituto Italiano di Idrobiologia, Pallanza.
Domenico Povoledo, and Marco Gerletti.
Summary in Italian. Memorie dell'Istituto Italiano di Idrobiologia, Vol 17, p 115-150, 1964. 14 fig, 5 tab, 49 ref.

Descriptors: *Lakes, *Sediments, *Organic matter, Chromatography, Hydrolysis, Phosphates, Sodium compounds, Copper, Amino acids, Carbohydrates, Heterogeneity, Chemical analysis, Fluorescence, Analytical techniques.
Identifiers: *Lake Maggiore (Italy), Gel filtration, Sodium hydroxide, Barium precipitation, Lead precipitation, True fulvic acids, Folin-Ciocalteu phenol test, Orcinal test, Elution patterns.

Samples of sediments were collected from Lake Maggiore near Isola Madre, at 60 to 80 meter depths, far from polluted water. A combination of gel filtration chromatography and fractional precipitation by heavy metals permitted separation of several fractions of organic matter of lacustrine sediments. These fractions were subjected to acid hydrolysis and further investigated for their amino acid and monosaccharide constituents. The results confirmed that the acid soluble compounds, extractible from lake sediments by mild alkaline solutions, are not chemically homogeneous. The heterogeneity of the Ba-S solution was revealed not only by its gel filtration chromatographic behavior, but also by the presence of constituents of different nature: polyphenols, peptides, and polysaccharides. It appears that bacterial mucopolysaccharides contribute to their formation. These findings provide better understanding of problems linked with sedimentary organic matter. (Wilde-Wisconsin)
W70-05759

SEDIMENT MEASUREMENT TECHNIQUES: E. AIRBORNE SEDIMENT.
For primary bibliographic entry see Field 07B.
W70-05886

MINERALOGY OF THE SUSPENDED SEDIMENT IN THE TIGRIS, EUPHRATES, AND SHATT-AL-ARAB RIVERS OF IRAQ, AND THE RECENT HISTORY OF THE MESOPOTAMIAN PLAIN,
Baghdad Univ. (Iraq). Dept. of Geology.
Richard W. Berry, Gerald P. Brophy, and Adnan Naquash.
Journal of Sedimentary Petrology, Vol 40, No 1, p 131-139, March 1970. 9 p, 2 fig, 12 ref.

Descriptors: *Suspended load, *Clay minerals, *Provenance, Flood plains, Rivers, Mineralogy, Deposition (Sediments), Geophysics, Water chemistry, Sampling, Chemical analysis.
Identifiers: Tigris River, Euphrates River, Iraq.

Clay mineral fractions of the Euphrates and Tigris Rivers show marked differences related to the nature of the provenance area. The Euphrates is richer in both chlorite and expandable lattice clays. All the suspension load of the two rivers is deposited prior to entering the Persian Gulf. Minimum sediment accumulation in the lower Mesopotamian Plain is 0.1 cm/year, but if restricted to the marsh areas is 1.0 cm/year. Downwarp to form the present plain began in upper Miocene and is presently continuing. Marginal upwarping has occurred since human habitation of the region. (Knapp-USGS)
W70-05891

A NEW RECORDING TURBIDITY METER FOR RIVERS,
Natal Univ., Durban (South Africa).
For primary bibliographic entry see Field 07B.
W70-05901

2K. Chemical Processes

EFFECT OF LIGHT INTENSITY AND THICKNESS OF CULTURE SOLUTION ON OXYGEN PRODUCTION BY ALGAE,
Naval Research Laboratory, Washington, D.C. Chemistry Div.
R. L. Shuler, and W. A. Affens.
Applied Microbiology, Vol 19, No 1, p 76-86, 1970. 10 fig, 3 tab, 5 ref.

Descriptors: *Chlorella, *Light, *Photosynthetic oxygen, *Algae, Cultures, Volume, Mathematical studies, Correlation analysis.
Identifiers: *Chlorella pyrenoidosa, Oxygen production, Light intensity, Culture thickness, Culture volume.

Objective was to optimize oxygen production efficiency for use in closed systems, such as submarines. Mathematical relationship between oxygen production rate, by Chlorella pyrenoidosa

(Sorokin strain--optimum temperature 39C), light intensity, culture thickness, and volume of suspension were worked out using a single type culture vessel. The vessel was an upright cylinder with the incandescent light source (also an upright cylinder) located centrally. The culture medium was pumped through continuously. Culture cell densities of 0.5 to 1.55% wet packed cell volumes were such that experimental data were collected on light limited cells undergoing log growth. Light intensities of 12,000-70,000-foot candles were employed. Culture thickness was varied by the use of separate annular compartments around the single light source. Cooling water was pumped continuously in a layer between lamp and culture vessel so as to maintain temperature at 38.5C. The conclusion was that oxygen evolution rate was a log function of light intensity and that rate of oxygen evolution per unit volume of culture is related linearly to the reciprocal of culture thickness. The relationships cited for the cylindrical vessel may have wide applicability. Efficiencies with respect to electrical (light) requirements were computed. (Gerhold-Wisconsin)
W70-05547

HYDROCHEMICAL INTERPRETATION OF GROUNDWATER MOVEMENT IN THE RED RIVER VALLEY, MANITOBA,
Department of Energy, Mines and Resources, Ottawa (Ontario).
For primary bibliographic entry see Field 02F.
W70-05638

PROPERTIES OF TILE DRAINAGE WATER,
Iowa State Univ., Ames.
T. L. Willrich.
Available from the Clearinghouse as PB-191 064, $3.00 in paper copy, $0.65 in microfiche. Completion Report Iowa State Water Resources Research Institute, December 31, 1969. 39 p, 16 tab. Project No. A-013-IA.

Descriptors: *Nitrogen, *Nutrients, *Pesticides, Pollution, *Properties, Drainage, Phosphorus, Tile drainage, Water.

Water samples from 10 tile drainage outlets were collected and analyzed about twice a month whenever flow occurred. The drainage systems were located on commercial farms in the Clarion-Webster soil association area of north central Iowa. Drainage areas ranged from 6 to 366 acres. Major portions of all areas were intensively cropped. Corn and soybeans were the usual crops. Median values for properties tested routinely ranged as follows: total N - 12 to 27 mg/l, P - 0.1 to 0.3 mg/l, K - 0.2 to 0.8 mg/l, hardness - 350 to 440 mg/l as $CaCO_3$, alkalinity - 260 to 330 mg/l as $CaCO_3$, specific conductance - 350 to 460 micromhos/cm, and pH - 7.4 to 7.8. Practically all of the total N was in the nitrate form. Usual values for the other N fractions were: org. N - <0.05 mg/l, NH4-N - <0.10 mg/l, and NO2-N - <0.01 mg/l. Average annual amounts of N fertilizer applied during the 5 years ranged from 18 to 89 pounds per acre for the drainage areas studied. Factors in addition to the amounts of applied fertilizer influenced N concentrations in the drainage water based on comparisons of results obtained from all areas and of yearly results from the same areas. Properties tested occasionally included amounts of pesticide residues, chemical oxygen demand and sulfur. No chlorinated hydrocarbon residues were detected except as laboratory glassware contaminants. COD values ranged from 0 to 14 mg/l. Inorganic S values ranged from 10 to 40 mg/l.
W70-05642

THE RELATION OF PHYTOPLANKTON PERIODICITY TO THE NATURE OF THE PHYSICOCHEMICAL ENVIRONMENT WITH SPECIAL REFERENCE TO PHOSPHORUS. I. MORPHOMETRICAL, PHYSICAL AND CHEMICAL CONDITIONS,
Michigan State Univ., East Lansing.
Allan Tucker.
American Midland Naturalist, Vol 57, p 300-333, 1957. 8 fig, 13 tab.

Descriptors: *Chemical analysis, *Chemical properties, *Physical properties, Lakes, Nutrients, Phosphorus, Phosphorus compounds, Oxygen, Carbonate, Carbon dioxide, Bicarbonates, Conductivity, Hydrogen ion concentration, Temperature, Water chemistry, Water quality, Michigan phytoplankton.
Identifiers: Morphometry, Douglas Lake (Mich), Lancaster Lake (Mich), Munro Lake (Mich), Vincent Lake (Mich), Lake Lansing (Mich).

The results of physical and chemical studies on five morphometrically differing lakes (Douglas Lake, Lancaster Lake, Munro Lake, Vincent Lake, and Lake Lansing) in Michigan are reported. The data include seasonal and vertical distributions of temperature, conductivity, oxygen, free carbon dioxide, carbonates, bicarbonates, pH, and phosphorus. The phosphorus fractions analyzed are soluble inorganic phosphorus, organic phosphorus, and total phosphorus. (Koonce-Wisconsin)
W70-05647

THE RELATION OF PHYTOPLANKTON PERIODICITY TO THE NATURE OF THE PHYSICOCHEMICAL ENVIRONMENT WITH SPECIAL REFERENCE TO PHOSPHORUS. II. SEASONAL AND VERTICAL DISTRIBUTION OF THE PHYTOPLANKTON IN RELATION TO THE ENVIRONMENT,
Michigan State Univ., East Lansing.
Allan Tucker.
The American Midland Naturalist, Vol 57, p 334-370, 1957. 8 fig, 3 tab, 50 ref.

Descriptors: *Algae, *Phytoplankton, Nutrients, Phosphorus, Water quality, Distribution patterns.
Identifiers: Phytoplankton periodicity, Phytoplankton composition patterns, Morphometry.

Data from a qualitative and quantitative analysis of the seasonal and vertical distribution patterns of phytoplankton in five Michigan lakes are reported. The composition patterns of the phytoplankton are then compared to the physical and chemical conditions at the time of sampling. Little evidence could be derived that would indicate a strong predictive correlation between phosphorus concentrations and pulses in the phytoplankton population. The discussion also includes an extensive review of the literature on phytoplankton periodically available at the time of publication. (Koonce-Wisconsin)
W70-05648

RELATIVE QUANTUM EFFICIENCY OF VISIBLE AND INFRARED LIGHT ON PHOTOSYNTHETIC 02 PRODUCTION,
Research Lab. in Plant Physiology, Penningby (Sweden).
Henrik G. Lundegardh.
Proceedings of the National Academy of Sciences, USA, Vol 59, No 1, p 293-295, 1968. 3 fig, 2 tab, 3 ref.

Descriptors: *Oxygen, *Photosynthesis, Light, Color, Absorption, Wavelengths, Efficiencies, Chlorophyll.
Identifiers: Oxygen production, Quantum efficiency, Chloroplast isolation, Light absorption, Thermoelectric measurements, Schott filters, Einsteins, B + L monochromator, Verlauf filters, Infrared light, Beta-carotene.

Chloroplasts isolated from spinach were diluted for determination of oxygen production to concentration of 0.04-0.06 milligram/milliliter. The suspension was exposed to illumination with a variety of filters. The trials showed a rapid decline of the quantum efficiency (Qeff) from wavelength 700 to 800 nanometers, caused by the low absorption of chlorophyll and beta-carotene, and a decreasing photosynthetic activity of infrared quanta. The complete process of photosynthesis, however, may include participation of infrared radiation. (Wilde-Wisconsin)
W70-05659

THE PRIMARY PRODUCTION IN LAKES: SOME RESULTS AND RESTRICTIONS OF THE C14 METHOD,
Uppsala Univ. (Sweden). Inst. of Limnology.
Wilhelm Rodhe.
Rapport et proces verbaux des Reunions. Conseil Permanent International pour l'Exploration de la Mer, Vol 144, p 122-128, 1958. 5 fig, 1 tab, 7 ref.

Descriptors: *Primary productivity, *Lakes, *Carbon radioisotopes, *Radioactivity techniques, Tracers, Photosynthesis, Respiration, Fresh water, Saline water, Light intensity, Seasonal, Nannoplankton, Cyanophyta, Winds, Standing crop, Phytoplankton, Chemical analysis, Nutrients, Phosphates, Nitrates, Oligotrophy, Eutrophication.
Identifiers: *Carbon-14 tests, Lake Erken (Sweden), Ceratium hirundinella, Lake Gorvaln (Sweden), Lappland, Zurich See (Switzerland), Bodensee (Switzerland), Lago di Garda (Italy), Lago di Varese (Italy), Uppland (Sweden), Lago Maggiore (Switzerland and Italy), Lac Leman (Switzerland).

This paper summarizes principal results obtained of primary productivity measurements with the C14 method in Swedish and other European lakes and discusses the problems common to C14 studies in all natural waters--salt and fresh. In all lakes investigated with fractionated C14 filtration, the rule was proven that contribution of nannoplankton algae to primary production exceeds that of net plankton algae. Some C14 experiments with additions of small amounts of phosphate, nitrate, and hypolimnic water, rich in organic compounds, have shown that an increased supply of these substances has a different effect on primary production at various seasons. The primary production within the subsurface layer of optimal light exhibits great regional variations. In addition to the aspects of primary production, the C14 method should permit better insight into utilization and transfer of energy in the metabolism of fresh and marine waters. By means of C14 tracers, efficiency of primary producers and primary consumers is quantitatively measureable, but, for such studies in particular, it is essential to get full evidence of the physiological significance of the C14 uptake, especially its bearing to photosynthesis and respiration (gross and net production). (Jones-Wisconsin)
W70-05669

GEOHYDROLOGIC INTERPRETATIONS OF A VOLCANIC ISLAND FROM ENVIRONMENTAL ISOTOPES,
Geological Survey, Washington, D.C.; Atomic Energy Research Inst., Seoul (South Korea); and International Atomic Energy Agency, Vienna (Austria).
George H. Davis, Chang Kun Lee, Edward Bradley, and B. R. Payne.
Water Resources Research, Vol 6, No 1, p 99-109, February 1970. 11 p, 7 fig, 2 tab, 6 ref.

Descriptors: *Hydrogeology, *Groundwater movement, *Tracers, *Tracking techniques, *Radioactivity techniques, Deuterium, Tritium, Hydrology, Volcanoes, Radiochemical analysis, Aquifers, Geology, Streamflow, Rainfall-runoff relationships, Water resources, Investigations, Surveys.
Identifiers: Korea, Cheju Island.

Isotopic analyses of groundwaters collected from 1966 through 1968 on Cheju Island, Republic of Korea, have proved helpful in interpreting the general hydrologic relations and in developing a model of the groundwater flow system in the permeable volcanic rocks of the island. Comparison of tritium and stable isotope contents provided a basis for a model of the groundwater flow regimes. Time variability of these isotopes determined by repeated samplings provided the basis for estimates of mean residence time of groundwaters, ranging from about 2 to 9 years. Although the results are only approximate because simplified models were used, they can be of substantial assistance in planning further hydrologic investigations and appraising the feasibility of groundwater development. (Knapp-USGS)
W70-05672

REPORT ON SEA WATER DESALINATION ANALYTICAL PROCEDURES,
Beach Test Facility, N.C. Wrightsville.
For primary bibliographic entry see Field 03A.
W70-05714

IRON IN GROUND WATERS OF THE MAGOTHY AND RARITAN FORMATIONS IN CAMDEN AND BURLINGTON COUNTIES, NEW JERSEY,
Geological Survey, Trenton, N.J.
Donald Langmuir.
New Jersey Division of Water Policy and Supply Water Resources Circular No 19, 1969. 49 p, 9 fig, 4 tab, 16 ref, append.

Descriptors: *Water quality, *Groundwater, *New Jersey, *Iron, Withdrawal, Water level fluctuations, Hydrogeology, Data collections, Hydrologic data, Aquifers, Water wells, Water pollution sources, Groundwater movement, Water chemistry.
Identifiers: Camden County (NJ), Burlington County (NJ).

Iron is the major water-quality problem in potable groundwaters of the Magothy and Raritan aquifer system in Camden and Burlington Counties, New Jersey. Most wells tapping the aquifer system in this area yield total iron concentrations in excess of 0.3 mg/liter. The iron is present primarily as dissolved ferrous iron, and as colloidal-sized ferric hydroxide. The water-quality and geohydrologic data suggest that heavy, long-term pumpage in the vicinity of Philadelphia and adjacent parts of New Jersey, has induced the flow of groundwaters up to 7 miles in a northerly direction toward this area since 1900. A reduction in pumpage in the Philadelphia area, coupled with increased pumpage in adjacent New Jersey during the period from 1958 to 1966, has brought about movement of up to 1 mile toward the southeast in Camden County. Adjustment of the groundwater within the aquifer system to marked seasonal changes in pumpage may cause local groundwater movement of up to 1 mile with corresponding changes in iron content. (Knapp-USGS)
W70-05723

2L. Estuaries

WASTE-INDUCED OXYGEN UPTAKE OF AN ALASKAN ESTUARY,
Alaska Univ., College. Dept. of Environmental Health Engineering; and Alaska Univ., College. Inst. of Water Resources.
R. Sage Murphy, and Ann P. Miller.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 94, SA 2, No 5908, p 345-354, 1968. 5 fig, 3 tab, 5 ref.

Descriptors: *Estuaries, *Sewage, Alaska, Biochemical Oxygen Demand, Biodegradation, Waste assimilation capacity, Water purification.
Identifiers: Cook Inlet (Alas), Knik Arm (Alas), Anchorage (Alas).

A study is reported to determine the possible biological effects of sewage discharge generated by Anchorage, Alaska, upon the waters of Knik Arm, a portion of Cook Inlet, to determine optimum disposal method. Large quantities of fine silt and low ambient temperatures of Knik Arm made standard biochemical oxygen demand (BOD) procedure inappropriate as a method for predicting the biological activity of the waters. Natural waters and 2C incubation temperatures were substituted for standard BOD procedure and comparisons with standard BOD values made. At 2C incubation temperature, figures are presented which compare oxygen uptake between waters inoculated with settled sewage, and oxygen consumption by selectively removing sewage or natural water-originating organisms. Considerable oxygen uptake is observed in waters when incubation temperature is 2C. A mixture of sewage and natural water exhibits much greater oxygen consumption than natural water alone. The concentration of silt does not have an appreciable effect upon oxygen consumption. Organisms indigenous to the natural waters have greater effect on decomposition of sewage than sewage-originating organisms. (Haskins-Wisconsin)
W70-05556

FURTHER OBSERVATIONS ON CHANGES IN THE BOTTOM FAUNA OF A FERTILIZED SEA LOCH,
University Coll., Southampton (England).
J. E. G. Raymont.
Journal of the Marine Biological Association of the United Kingdom, Vol 28, p 9-19, 1949. 1 fig, 4 tab, 10 ref.

Descriptors: *Fertilizers, *Sea water, *Bays, Hydrology, Oxygen, Productivity, Nutrients, Sampling, Crustaceans, Phytoplankton, Density, Marine plants, Hydrogen sulfide, Grazing, Fish.
Identifiers: *Bottom fauna, Loch Craiglin (England), Flatfish, Chironomids, Hydrobia ulvae, Cardium, Idothea, Gammarus, Lock Sween, Flounders, Zostera.

Changes in the bottom fauna of a fertilized sea loch during 1944-1947 are compared with those in 1942-1944. The density fell markedly during 1944 despite large fertilizer additions, due to unfavorable hydrographic conditions, especially low oxygen tensions. Highest densities were found in 1945 summer (average of 23,000 animals per square meter) when hydrographic conditions were favorable. High productivity apparently was maintained during 1946, although only little fertilizer was added that year. By 1947 average density of bottom fauna had fallen to only 7500 animals per square meter. This drop may be correlated with less available nutrients, no fertilizers being added after January 1946. Hydrobia ulvae, progressively important from 1944 onward, was the dominant member from 1945. Average dry weight of bottom fauna flesh was 3 grams/square meter in 1942, 9 grams/square meter in summer of 1943, 3.5 grams in 1944, 19.5 grams in 1945, and 7.5 grams in summer of 1947. Constant application of fertilizers during at least two to three years are necessary for maximum production. Even after 2-1/2 years, bottom fauna production was more than twice that of 'natural' conditions. (Jones-Wisconsin)
W70-05569

POTABLE WATER AVAILABILITY ON LONG OCEANIC ISLANDS,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
Eugene Wallace Rochester, Jr.
Available from the Clearinghouse as PB-191 068, $3.00 in paper copy, $0.65 in microfiche. PhD Thesis, 1970. 66 p, 7 tab, 14 fig, 30 ref, 4 append. OWRR Project No. B-006-NC.

Descriptors: *Islands, *Potable water, *Infiltration, *Saline water, Freshwater interfaces, Saline water intrusion, Interfaces, *Pumping, Induced infiltration, Boundaries (Surfaces), Free surfaces, Flow rates.

Laboratory experiments were conducted to predict maximum safe pumping rates that can be obtained for various soil and rainfall conditions on long oceanic islands. Particular emphasis was given to obtaining potable water on the barrier islands of North Carolina. A Hele-Shaw model was designed and built to represent a cross section of a long oceanic island. The two fluids which simulated fresh water and salt water were obtained by adding a viscosity-increasing agent to water. The density of one batch was increased by adding salt and sugar. The 'fresh water' was added along the top of the fresh-water lens in the model at cyclic time intervals. Fluid was pumped from the fresh-water lens through one of three galleries. Two of the galleries were located below mean sea level, and one was located at mean sea level. During a test, pumping from a gallery was initiated at a low rate and was continued at that rate until equilibrium of the interface was obtained. The pumping rate was increased in increments allowing equilibrium to be reached at each increment until the maximum continuous rate was obtained. Pumping stopped when the free surface was pulled to the top of the gallery or when salt water was pumped into the gallery. Locations of the free surface and interface were recorded for each pumping rate and were presented graphically in dimensionless form. The maximum pumping rate was presented as a function of infiltration and island characteristics. The mathematical boundary conditions and flow equation for the two-dimensional flow problem were also presented.
W70-05646

SOME ASPECTS OF LITTORAL ECOLOGY: THE PARAMETERS OF THE ENVIRONMENT, THEIR MEASUREMENT: COMPETITION, INTERACTION AND PRODUCTIVITY,
Dunstaffnage Marine Research Lab., Oban (Scotland).
Harold Barnes.
American Zoologist, Vol 9, No 2, p 271-277, 1969. 1 fig, 1 tab, 22 ref.

Descriptors: *Littoral, *Ecology, *Environment, *Competition, *Productivity, Algae, Fisheries, Herrings, Zooplankton, Tides, Mathematical models, Diatoms, Basins, Coasts, Statistics, Humidity, Carbon dioxide.
Identifiers: Patella, Aplysia, Balanus balanoides, Nauplii, Entermorpha, Cladophora, Loch Craiglin (Scotland), Lake bottoms, Radiant heat.

The ease of study of littoral ecology is offset by its complexity. Priorities to which aspects of the physical environment are relevant to a given problem should be considered. This complexity, extending to substratum itself, gives possibility of myriads of biotopes for which the more obvious physical parameters are only distantly related to the values of the same parameters as usually measured. The most characteristic feature of the littoral is that it is regularly exposed to air. Problems associated with humidity, radiant heat, or accumulation of carbon dioxide have not been solved. On the shore, plants are primary producers but in direct competition with many animals for space. Attachment to shells is less secure than to rock. This difference plays a distinct part in competition between algae and animals and affects relative distribution in relation to wave action. Problems of mobility of the substratum under wave action become of paramount importance. The flora and fauna may be very different from those on an open coast. Perhaps some of the greatest advances in ecological thought will come from more detailed work in tropical, or at least warm waters. Application of all available techniques, instrumentation and analysis, is necessary. (Jones-Wisconsin)
W70-05649

THE USE OF THE COULTER COUNTER FOR THE DETERMINATION OF MARINE PRIMARY PRODUCTIVITY,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
For primary bibliographic entry see Field 07B.
W70-05650

ON THE QUANTITATIVE DISTRIBUTION OF ZOOPLANKTON IN DEEP SCATTERING LAYERS,
Hamburg Univ. (West Germany). Institute fuer Hydrobiologie und Fischereiwissenschaft.
Johannes Kinzer.
Deep-Sea Research, Vol 16, p 117-125, 1969. 6 fig, 28 ref.

Descriptors: *Oceans, *Zooplankton, Biomass, Depth, Copepods, Plankton, Sampling, Diurnal.
Identifiers: *Acoustic scattering layers, *ELAC echo-sounder, Eastern Atlantic Ocean, Arabian Sea, Euphausiids, Deep scattering layers, R V

Meteor cruises, Meteor Bank, Josephine Bank, Canary Islands, Karachi (Pakistan), Bombay (India), Myctophid fish, HAI-20 plankton sampler.

This study was concerned with contribution of zooplankton to the phenomenon of acoustic scattering layers. The plankton samples were collected with closing nets from the deep scattering layer (DSL), as it was recorded by an ELAC echosounder at a frequency of 15 kilocycles/second. In the Eastern Atlantic, the DSL (450-600 meters) had a significantly higher volume and number of organisms than the upper (150-450 meters) and the lower (600-700 meters) layers. The upper zone of the DSL had a somewhat higher density of copepods and euphausiids than other layers. A similar relationship was observed in the Arabian Sea, except that the plankton biomass in the oxygen-deficient part of the DSL was two-thirds less than in its upper part. Up to 90% plankton of Arabian Sea DSL consisted of copepods. Stomach analyses indicated that large populations of myctophid fish in the DSL, particularly Benthosema pterota, feed on copepods. (Wilde-Wisconsin)
W70-05662

FRAGILE ESTUARINE SYSTEMS-ECOLOGICAL CONSIDERATIONS,
Texas Univ., Port Aransas. Inst. of Marine Science.
Donald E. Wohlschlag, and B. J. Copeland.
Water Resources Bulletin, Vol 6, No 1, p 94-105, January-February 1970. 12 p, 3 fig, 32 ref.

Descriptors: *Estuaries, *Ecology, *Aquatic habitats, *Aquatic environment, Aquatic life, Water pollution effects, Estuarine environment.
Identifiers: Estuarine ecology.

Studies of fish species and populations indicate a high degree of fragility for estuarine ecosystems. Slight stresses tend to disrupt energy flow systems and lead to lower levels of biological productivity, shortened food chains and poorer diversity of species. For individual species low-level stresses tend to suppress metabolism and growth processes. Minor stresses can also substantially reduce populations. Stress processes are quantifiable and amenable to mathematical modeling. (Knapp-USGS)
W70-05709

ECOLOGICAL STUDY OF BOLINAS LAGOON, MARIN COUNTY, CALIFORNIA,
Resources and Ecology Projects, Mill Valley, Calif.
Joel F. Gustafson.
In: Proceedings Public Meeting on Water Quality Management for Estuaries, San Francisco, California, February 18-19, 1969, Vol 1, p 168-219, 1969. 52 p, 6 fig, 4 tab, 10 ref.

Descriptors: *Ecology, *Lagoons, *Channels, *Bays, *California, Bottom sediments, Productivity, Ponds, Shallow water, Saline water, Ecological distribution, Biological communities, Ecosystems, Surveys, Aquatic habitats.
Identifiers: Bolinas Lagoon (Calif).

The relationships of bottom sediment types and water chemistry to the distribution of plants and animals in Bolinas Lagoon, California, were studied by making a careful ecological inventory. The consistency of the bottom is as important as the quality of the water in determining the quantity and the variety of life forms living within the bottom material. Sediment particle size measurements and percentages of the total volumes were made for all but one of the stations. Major plant production occurs in shallow flats, both muddy sand and sandy mud, but much less so on sandy flats. Water turbidity and organic richness increase rapidly toward land. The extreme ends of the lagoon are very rich with organic matter, nearly all of which is detritus from marine plants except in and near fresh water marshes. The quantity and variety of life is much higher in muddy sand bottoms than in sandy mud. Use of the muddy sand flats by juvenile fish points out a higher wildlife importance of these areas. There is adequate space within the lagoon for wildlife, recreation and some limited harbor development. (Knapp-USGS)
W70-05713

PHOTOSYNTHETIC BACTERIA ISOLATED FROM THE ARAL SEA,
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Inst. of Microbiology and Virology; Moscow State Univ. (USSR). Dept. of Soil Biology; and Moscow Univ. (USSR). Dept. of Microbiology.
V. A. Loponitsina, M. I. Novozhilova, and E. N. Kondrat'eva.
Microbiology, Vol 38, No 2, p 299-303, 1969. 1 fig, 2 tab, 11 ref.

Descriptors: *Photosynthetic bacteria, Cultures, Depth, Sulfur bacteria, Chlorophyll, Mud, Hydrogen ion concentration, Oxygen, Salinity, Temperature, Sampling, Spectrometers, Pigments, Chromatography, Colorimetry, Light intensity.
Identifiers: *Aral Sea (USSR), Thiorhodaceae, Athiorhodaceae, Chlorobacteriaceae, Chromatium, Rhodothece, Rhodopseudomonas, Chlorobium limicola, Chloropseudomonas, Carotenoid composition, Physiological properties, Transparency, Rhodospirillium rubrum.

Results of the study of distribution of photosynthetic bacteria in the Aral Sea and determination of their composition and physiological properties is presented. Enrichment cultures of Thiorhodaceae, Athiorhodaceae, and Chlorobacteriaceae, were obtained from the surface layer of different substrates from various depths (4 to 61 meters), though no apparent growth of these microorganisms was observed in the muds. Purple sulfur bacteria were the most widely distributed, being found in 89 out of 99 mud samples. The following strains were obtained in pure cultures and monocultures: Chromatium sp, Rhodothece sp, Rhodopseudomonas sp, Chlorobium limicola, and Chloropseudomonas sp. All investigated strains of purple bacteria contained bacteriochlorophyll a; the green bacteria, bacteriochlorophyll c. Chromatium sp differed from Rhodothece sp in carotenoid composition which evidently caused the coloration difference of their cultures. Bacteria strains studied are close to one another in physiological properties. Cultivation of these bacteria under illumination at 45 to 50,000 lux showed their growth is possible under all conditions, but at light to 500 lux, culture growth occurs more slowly than at 1000 lux and higher. An inhibiting action of high light intensities was not found. (Jones-Wisconsin)
W70-05758

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DEVELOPMENT OF SULFONATED POLYPHENYLENE OXIDE MEMBRANES FOR REVERSE OSMOSIS,
General Electric Co., Lynn, Mass.
C. W. Plummer, Gene Kimura, and A. B. La Conti.
Office of Saline Water Research and Development Report No 551, 1970. 73 p. OSW Contract 14-01-0001-2114.

Descriptors: *Desalination, *Reverse osmosis, *Membranes, Membrane processes, Ion-exchange membrane.

Reverse osmosis membranes were prepared by sulfonating 2, 6 - dimethyl polyphenylene oxide. Membrane variables were ion-exchange capacity (2.0 - 3.0 meq. of H+/g of dry polymer), water content (80 - 200% based on dry polymer), and thickness (0.15 - 0.5 mils). The membrane's resistance to compaction and stability at high temperature was demonstrated in a 524 hour life test on synthetic Webster, S. D. water at 130 deg F and 1100 psi. During this test, the product water flux and salt rejection stabilized at 27 gfd and 85%, respectively. (Mintz-Office of Saline Water)
W70-05616

REGENERATION OF ACID WASTES FROM WATER DESALTING EQUIPMENT BY AN ELECTROCHEMICAL METHOD,
Argonne National Lab., Ill.
N. I. Isaev, and M. N. Romanov.
Argonne Lab Trans 788. Available from the Clearinghouse as PB-188 132T, $3.00 in paper copy, $0.65 in microfiche. Izestiya Uchebnykh Zavedenii. Khimiya i Khimicheskaya Tekhnologiya (USSR) v 12 n 7 p 24-928, 1969.

Descriptors: *Industrial wastes, *Electrochemistry, *Desalination, Ion exchange, Chemical engineering.
Identifiers: Hydrochloric acid, Calcium compounds, USSR.

Regeneration of acid wastes from water desalting equipment is carried out because of their subsequent use for regeneration of cation separators. Achieving this in practice permits a reduction in the consumption of concentrated acid entering into the preparation of regenerating solution, and also decreases the use of reagents for waste neutralization. To solve this problem, an electrochemical method is often applied. The relative effectiveness of 3 schemes for electrochemical process conversion of the industrial wastes was studied. It was shown that conditions for conducting the process for the regeneration of wastes, by which the formation of Ca (OH)2 precipitates are excluded, may be controlled by varying the pH of the working solution.
W70-05626

REPORT ON SEA WATER DESALINATION ANALYTICAL PROCEDURES,
Beach Test Facility, N.C. Wrightsville.
John R. Newton, and M. E. Atkins.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $1.25. Office of Saline Water Research and Development Progress Report No 450, May 1969. 133 p, 22 fig, 2 tab, 66 ref.

Descriptors: *Analytical techniques, *Water analysis, *Sea water, *Desalination processes, Methodology, Fresh water, Industrial water, Research and development, Brines, Gravimetric analysis, Instrumentation, Corrosion, Additives.
Identifiers: *Sea water analysis, *Office of Saline Water.

Standard methods used to analyze industrial and fresh waters were not satisfactory for analyzing sea water. The methods were evaluated and modified for use with sea water, brines, and product water at the Office of Saline Water's Wrightsville Beach Test Facility. This report includes colormetric, gravimetric, titrimetric, and instrumental methods of sea water analysis. Interferences which are not common to sea water may be present in samples due to process additives or corrosion of equipment and these interferences must be removed before the actual determination. (Carstea-USGS)
W70-05714

MODIFICATION OF PROTEIN FILMS FOR USE IN WATER DESALINATION,
Harris Research Labs., Inc. Washington, D.C.
Bruce S. Fisher, and Helen Y. Hsiao.
Report available for sale from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $0.60. Office of Saline Water Research and Development Progress Report No 482, December 1969. 57 p, 8 fig, 17 tab, 30 ref. OSW Contract No 14-01-0001-1811.

Descriptors: *Films, *Proteins, *Desalination processes, *Membrane processes, Permeability,

Osmosis, Membranes, Selectivity, Sodium chloride, Calcium chloride, Sodium sulfate, Brackish water, Research and development.
Identifiers: *Gluten, *Zein, Prolamine, Crosslinked Zein.

The mechanical and permeability properties of zein (the prolamine fraction of corn gluten) membranes were investigated under direct osmosis conditions. Crosslinked zein films at high states of cure had mechanical and permeability properties comparable to other desalination membranes. A 25% improvement in water permeability and 5% increase in the selectivity to sodium chloride were obtained by incorporation of 10-15 wt.% of poly (methacrylamide) in crosslinked zein films. Very high selectivities toward sodium chloride but low intrinsic water permeability were exhibited by films of acetyl zein. The relative permeability of crosslinked zein films to urea, NaCl, Ca chloride, Mg chloride, Na sulfate, Mg sulfate, and sucrose decreased in this order. The data suggest a potential use for zein as a barrier for desalination of high sulfate-content brackish waters. (Carstea-USGS)
W70-05715

RESEARCH ON POROUS GLASS MEMBRANES FOR REVERSE OSMOSIS,
McDonnell Douglas Astronautics Co., Newport Beach, Calif. Western Div.
F. E. Littman, and G. A. Guter.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, D C 20402 - Price 60 cents. Office of Saline Water Research and Development Progress Report No 505, 1970. 52 p, 10 fig, 22 tab, 9 ref, 2 append. OSW Contract No 14-01-0001-2110.

Descriptors: *Desalination processes, *Reverse osmosis, Membrane processes, Research and development, Membranes, Ion transport, Semipermeable membranes.
Identifiers: Glass membranes.

The use of 'porous glass' as membrane material for reverse osmosis was investigated in a continuing study. The relationships between manufacturing variables and performance as a reverse osmosis membrane were determined by exploring the effect of composition of the parent glass such as silica content, type of alkali, and other constituents. The conditions of the phase separation were optimized for each composition, and a novel leaching process worked out. The data suggest that useful combinations of salt rejection and flux can be obtained. The major remaining problem is the stabilization of the silica matrix to maintain high performance over long periods of time. Very promising results were obtained in the application of porous glass membranes to life support problems, such as urine and waste water recovery. High quality water was obtained from waste water and the ability of porous glass to handle raw urine without pretreatment was established. (Knapp-USGS)
W70-05890

3B. Water Yield Improvement

MULTIPURPOSE BENEFITS AND COSTS OF MODIFYING PLAYA LAKES OF THE TEXAS HIGH PLAINS,
Texas Technological Coll., Lubbock. Dept. of Agricultural Economics.
Herbert W. Grubb, and Don L. Parks.
International Center for Arid and Semi-arid Land Studies, Special Report Number 6, 66 p, February 1968. 1 fig, 16 tab, 3 append, 25 ref.

Descriptors: *Playas, *Soil texture, *Cost-benefit analysis, *Feasibility studies, *Water storage, Economics, Lake basins, Irrigation water, Mosquitoes, Public health, Texas, Semiarid climates, Runoff, Flood control, Economic feasibility, Costs.
Identifiers: *Playa modification, *Texas High Plains.

Modification of playa lakes in order to concentrate runoff water in deep, small-surface catchments would save water for irrigation use and protect lake-bed cropland from periodic inundation. It would also reduce the water area available for breeding of Culex tarsalis, a mosquito which spreads encephalitis. A study was undertaken to determine the economic feasibility of modifying playa lakes in the fine- and medium-textured soil area of the Texas High Plains. The costs of four different methods of modification were estimated for lakes of 2.5, 8, 15, 25, and 45 acres in both soil areas. Modification benefits were also calculated. Annual net income for each modification type less annual maintenance costs yielded an estimate of annual benefits. Benefits exceed costs for larger lakes (15, 25, and 45 acres) in the fine-textured soils. Modification costs would not be economically feasible for smaller lakes in the fine-textured soils, or for any lake sizes in medium-textured soils. The circular reservoir, Model III, was the modification method yielding the highest net benefits. This study reveals that it would be economically feasible and beneficial to modify 35 percent of the playas found in the Texas High Plains. (Carr-Arizona)
W70-05589

COMPARISON OF CHEMICAL AND NONCHEMICAL TECHNIQUES FOR SUPPRESSING EVAPORATION FROM SMALL RESERVOIRS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering; and Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
F. R. Crow, and H. L. Manges.
American Society of Agricultural Engineers, Transactions, Vol 10, No 2, p 172-174, March-April 1967. 4 fig, 4 tab, 5 ref.

Descriptors: *Evaporation control, *Evaporation, *Chemcontrol, *Monomolecular films, *Reservoir evaporation, Reservoirs, Water conservation, Baffles, Hexadecanol, Octadecanol, Wind velocity, Evaporation pans, Radiation, Barriers.
Identifiers: *Styrofoam, *Polypropylene mesh, *Small reservoirs.

Most research into the problem of evaporation control has concentrated on chemical methods of evaporation suppression. It is possible that there are non-chemical means which have been overlooked. Experiments are described in which wind baffles, styrofoam, and polypropylene mesh were tested singly and in combination with chemical films to observe their ability to reduce evaporation. Results indicate that a combination of chemical and non-chemical techniques is the most effective method for controlling evaporation on small reservoirs. The best combination appears to be polypropylene mesh and monomolecular film. The mesh not only reduces wind speed at the water surface, but also reflects incoming radiation. (Carr-Arizona)
W70-05606

FOREST LAND USE AND STREAMFLOW IN CENTRAL OREGON,
Forest Service (USDA), Wenatchee, Wash. Pacific Northwest Forest and Range Experiment Station.
H. W. Berndt, and G. W. Swank.
U.S.D.A. Forest Service Research Paper PNW-93, 1970. 15 p, illus.

Descriptors: *Forest management, *Watershed management, *Water yield, *Ponderosa pine trees, Vegetation effects, Lumbering, Small watersheds, Double-mass curves, Reservoir operation, Irrigation water, Grazing, Mining.

A case study was made of land management activities and hydrologic performance of a small, forested basin in central Oregon for the period 1922-65. A significant increase in streamflow, amounting to 2.21 inches, beginning about 1942 was noted. In reviewing land use history, this change in water yield closely coincides with increased timber cutting activity within the basin. Other elements of past and present land use, as well as climatic shifts, are considered. Though sensitive tests of the influence of vegetation on water yield east of the Cascade Range are yet needed, these analyses of existing records provide some insight to the interacting character of forest management activities. (Berndt-USFS)
W70-05618

EFFECTS OF KAOLINITE AS A REFLECTIVE ANTITRANSPIRANT ON LEAF TEMPERATURE, TRANSPIRATION, PHOTOSYNTHESIS, AND WATER-USE EFFICIENCY,
California Univ., Davis.
For primary bibliographic entry see Field 2D.
W70-05635

ECOLOGICAL EFFECTS OF SILVER IODIDE AND OTHER WEATHER MODIFICATION AGENTS: A REVIEW,
Michigan Univ., Ann Arbor, School of Natural Resources.
For primary bibliographic entry see Field 05C.
W70-05671

EVAPOTRANSPIRATION FROM BARE, HERBACEOUS, AND ASPEN PLOTS: A CHECK ON A FORMER STUDY,
Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.
Robert S. Johnston.
Water Resources Research, Vol 6, No 1, p 324-327, February 1970. 4 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Evapotranspiration control, *Evapotranspiration, *Water yield improvement, *Forest management, *Clear-cutting, Nuclear moisture meters, Soil moisture, Transpiration control.
Identifiers: Neutron moisture measurements.

Soil moisture depletion was measured and evapotranspiration estimated on 3 high elevation plots with 3 cover conditions: bare, herbaceous, and aspen-herbaceous. Neutron moisture measurements were taken to a depth of 9 feet. The 4-year average annual evapotranspiration losses were 11.28, 15.27, and 21.00 inches from the bare, herbaceous, and aspen-herbaceous plots, respectively. Summer rainfall varied from 1.13 to 10.43 inches during this study. The results of this present study substantiate an earlier report concerning the comparative water savings to be realized on the same plots by vegetative manipulation. They show that removing deep rooted aspen can reduce the average evapotranspiration by about 6 inches per year from a 9-foot profile. (Knapp-USGS)
W70-05693

THE FLOW INTERVAL METHOD FOR ANALYZING TIMBER HARVESTING EFFECTS ON STREAMFLOW REGIMEN,
Forest Service (USDA), Parsons, W. Va. Northeastern Forest Experiment Station.
Charles A. Troendle.
Water Resources Research, Vol 6, No 1, p 328-332, February 1970. 5 p, 2 tab, 9 ref.

Descriptors: *Water yield improvement, *Forest management, *Clear-cutting, *Streamflow forecasting, Watershed management, Peak discharge.
Identifiers: Timber harvesting.

A flow interval method of determining the timing of significant portions of annual streamflow was applied to the discharge data from five small mountain watersheds (four treatment watersheds and one control watershed) in West Virginia. Different degrees of timber harvesting had varying effects on the interval lengths and occurrence. The heavier cuttings caused an apparent lengthening in the shortest 25% and 50% intervals. In nearly every instance harvesting resulted in a decrease in the length of the longest 1% and 5% intervals. (Knapp-USGS)
W70-05694

PHYSICAL VIEW OF CLOUD SEEDING,
Department of Commerce, Washington, D.C.; and Federal Council for Science and Technology, Washington, D.C.
Myron Tribus.
Science, Vol 168, No 3928, p 201-211, April 10, 1970. 11 p, 4 fig, 29 ref.

Descriptors: *Cloud seeding, *Cloud physics, *Snow management, *Environmental effects, Rain stimulation, Artificial precipitation, Weather modification, Statistical methods, Hurricanes, Hail, Orography.
Identifiers: *Weather control, Experimental data, Conflict of interests.

Experimental cloud-seeding information is reviewed and the scientific view is particularized to specific applications. The use and misuse of statistics are discussed. Seeding at low temperatures produces many kinds of particles that can act as ice-nucleating agents resulting in overseeded conditions and less rainfall, whereas seeding at higher temperatures produces fewer active nuclei and can increase rainfall. Indiscriminate seeding without knowledge of cloud physics involved can lead to unintended results. Described are topics dealing with lakeshore snow removal, stratus and cumulus clouds related to rain prospects, hail reduction, hurricane modification, and requirements for operational weather modification. Experiences cited show that capabilities for successful cloud seeding now exist in two areas: (1) the increase or decrease of snowpack in some mountains; and (2) the increase of rainfall in some tropical regions. Weather can and will be controlled to the extent that state of the art allows us; we must keep in mind that weather modification means changing the environment, perhaps on a large scale. (Lang-USGS)
W70-05893

THE EFFECT OF ALBEDO-REDUCING MATERIALS ON NET RADIATION AT A SNOW SURFACE,
Forest Service (USDA), Ogden, Utah; Forest Service (USDA), Fort Collins, Colo.; and Colorado State Univ., Fort Collins. Dept. of Watershed Resources.
W. F. Megahan, J. R. Meiman, and B. C. Goodell.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 69-80, March 1970. 12 p, 4 fig, 4 tab, 8 ref.

Descriptors: *Snowmelt, *Albedo, *Water yield improvement, *Snow management, Snowpacks, Water yield, Solar radiation, Melting, Radiation, Snow, Heat budget.
Identifiers: Albedo reduction.

Various albedo-reducing materials were used to increase net radiation at the surface of ripe snow. Increases were evaluated by measuring net radiation on small plots of treated and untreated snow for the period of 1 day. Nine different materials were applied at different weights per unit area for a total of 47 treatments. During short periods of variable incoming radiation, the relation between net radiation on treated and untreated snow was linear. Treatment effects decreased with time for carbon black materials applied at low weights. Net radiation increases averaged for the day were statistically significant in all cases and ranged from 37 to 122% for the various treatments. There was a tendency for the amount of treatment effect to be directly proportional to the weight per unit area of darkening material applied up to a point, above which treatment effects did not increase. Carbon black treatments were more effective than fluid coke and small particles of fluid coke were more effective than large particles. New snow tended to decrease treatment effects, but net radiation was still significantly greater on treated snow as compared to untreated snow, even with up to 4.1 cm of new snow on treated surfaces. (Knapp-USGS)
W70-05903

3C. Use of Water of Impaired Quality

DRIP IRRIGATION - A METHOD USED UNDER ARID AND DESERT CONDITIONS OF HIGH WATER AND SOIL SALINITY,
D. Goldberg, and M. Shmueli.
American Society of Agricultural Engineers, Transactions, Vol 13, No 1, p 38-41, January-February 1970. 10 fig, 3 tab, no ref.

Descriptors: *Irrigation effects, *Irrigation design, *Arid lands, *Saline soils, *Saline water, Salinity, Deserts, Soil texture, Crop production, Irrigation systems, Nozzles, Irrigation water, Irrigation engineering, Irrigation efficiency, Furrow irrigation, Fertilizers, Equipment.
Identifiers: *Drip irrigation, *Israel.

Drip irrigation has many advantages over other forms of irrigation when used in arid regions characterized by saline soil, saline irrigation water, and high evapotranspiration rates. It shortens growing seasons, produces earlier crops, increases crop yield, and makes it possible to grow crops which would normally be salt-damaged. A summary of experimental results is presented which support these conclusions. Also a technical description of the system is included and certain soil problems as they relate to the drip irrigation method are discussed. (Carr-Arizona)
W70-05607

3D. Conservation in Domestic and Municipal Use

MULTIPLE PURPOSE USE OF THERMAL CONDENSER DISCHARGES FROM LARGE NUCLEAR SYSTEMS TO SUPPLEMENT INTER-REGIONAL WATER SUPPLY,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. T. Jaske, M. H. Karr, and C. J. Touhill.
67th National Meeting of the AIChE, Atlanta, Paper No. 26E, p 17, February 17, 1970. 2 fig, 3 tab, 7 ref.

Descriptors: *Temperature, *Water supply, *Nuclear power plants, Cooling water, Irrigation, Evaporation, Planning, Thermal capacity.
Identifiers: *Canal-lake system, *Thermal discharge.

The multipurpose use of canal-lake systems as cooling conduits, in conjunction with other uses appears to offer considerable advantage in the redirection of metropolitan growth rates along planned lines. A 1000 MW thermal station requires the passage of from 800 to 1200 cfs of water through the condenser system. The flow of two of these plants would supply the entire water use needs of the cities of Chicago, Los Angeles, or metropolitan New York. A total of 30 GWe, a substantial fraction of the western firm power requirements through the year 2000 could be sited on the canal system. The annual evaporation chargeable to the thermal plant system using the canal-lake complex was 30% lower than the equivalent in direct cooling tower capacity (452,000 AF vs. 650,000 AF) annually. But the total evaporation of the system was considerably larger. A substantially larger canal throughout would not increase the base evaporation levels, and smaller systems optimized for thermal cooling canals would suffer relatively large disadvantages from evaporation unless considered as multipurpose for irrigation, navigation and land development in arid regions. Advantages of the proposed canal-lake system are that nuclear stations can be located far from centers of population. The large transmission system could parallel and reinforce local grids. The canal-lake system provides very large heat dissipative capacity without disturbing environmental esthetics of existing population centers. (Upadhyaya-Vanderbilt)
W70-05784

A NATIONAL ESTIMATE OF PUBLIC AND INDUSTRIAL HEAT REJECTION REQUIREMENTS BY DECADES THROUGH THE YEAR 2000 A.D.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 06B.
W70-05787

WASTE LIQUORS FROM THE MERCERIZATION OF COTTON FABRICS AND LIMITING OF WASTE WATER ALKALINITY (IN CZECH),
For primary bibliographic entry see Field 05D.
W70-05865

3F. Conservation in Agriculture

QUALITY AND SIGNIFICANCE OF IRRIGATION RETURN FLOW,
Washington Univ., Seattle. Dept. of Civil Engineering; and Washington Univ., Seattle. Dept. of General Engineering.
Robert O. Sylvester, and Robert W. Seabloom.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 89, IR 3, p 1-27, 1963. 9 fig, 6 tab, 29 ref.

Descriptors: *Return flow, *Irrigation effects, *Leaching, Water quality, Ion exchange, Evapotranspiration, Salts, Irrigation water, Water reuse, Drainage effects, Water injury, Analytical techniques, Sewage treatment, Effluents, Irrigation programs.
Identifiers: Yakima River Valley (Wash), Return flow study.

This paper examines evapotranspiration, leaching, ion exchange, erosion, filtration, heat transfer, precipitation of salts and colloids, and biochemical alteration of water and soil constituents and how they alter the quality of water as it passes over or through soil being irrigated. A study technique is outlined to carry out a return flow water quality study to provide data that will permit evaluation of return flow water quality for multi-purpose reuse. Studies should be broad enough to provide data that can be extrapolated to future irrigation projects, and should indicate improvements that may be made in localized areas in regard to water conservation and return water quality. To illustrate the technique, a summary of a study made on the character and significance of irrigation return flow originating from irrigation of a wide variety of crops in the Yakima River Valley in Washington is presented together with a comparison of the impact on Yakima River water quality by irrigation return flows and municipal and industrial waste water discharges. In the lower Yakima River approximately 56% of the river salt content was contributed by irrigation return flows. Leaching was the primary process responsible. (Haskins-Wisconsin)
W70-05563

CHARACTERIZATION OF SOIL AERATION DURING SPRINKLER IRRIGATION,
North Dakota State Univ., Stillwater. Dept. of Agricultural Engineering; Michigan State Univ., East Lansing. Dept. of Agricultural Engineering; and Michigan State Univ., East Lansing. Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W70-05591

PERFORMANCE CHARACTERISTICS OF SELF-PROPELLED CENTER-PIVOT SPRINKLER IRRIGATION SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.

D. F. Heermann, and P. R. Hein.
American Society of Agricultural Engineers, Transactions, Vol 11, No 1, January-February 1968. p 11-14, 8 fig, 3 tab, 4 ref.

Descriptors: *Sprinkler irrigation, *Distribution systems, *Rates of application, *Application equipment, Application methods, Irrigation systems, Irrigation practices, Irrigation, Equipment, Sprays, Sprinkling, Equations, Mathematical models, Depth.
Identifiers: *Center-pivot sprinkler irrigation.

Mathematical equations are formulated and solved for application rates and depths on a center pivot sprinkler system. Field measurements are compared with theoretical solutions for distribution of depth from the system. Application rate increases radially outward from the pivot point; application time decreases correspondingly. Necessary formulation is provided for properly designing a self-propelled, center-pivot, sprinkler irrigation system. (Carr-Arizona)
W70-05593

LABORATORY METHOD FOR SUPPLYING MOISTURE UNIFORMLY TO SOIL BY CONDENSATION,
Battelle Memorial Inst., Richland, Wash.; North Dakota Univ., Grand Forks. Dept. of Engineering; Oregon State Univ., Corvallis. Dept. of Mathematics; and Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
D. S. Trent, M. B. Larson, C. Y. Shen, J. E. Postlewaite, and J. W. Wolfe.
American Society of Agricultural Engineers, Transactions, Vol 11, No 4, p 519-522, July-August 1968. 6 fig, 5 ref.

Descriptors: *Soil moisture, *Condensation, *Air circulation, *Thermal conductivity, *Temperature control, Temperature, Flow rates, Irrigation, Plant physiology, Equations, Instrumentation.

The three experimental objectives were: (1) to determine if it were theoretically possible to uniformly condense moisture in a cooled soil test bed from the flow of water-saturated air, (2) to discover a practical means of controlling such moisture deposition, and (3) to decide if the technique were a suitable instrument to aid laboratory research in plant physiology. Theory demonstrates that it is probably impossible, and certainly impractical, to obtain perfect moisture uniformity. However, greatest uniformity can be achieved by minimum variation in temperature. To control this temperature distribution, pins made from material having a higher thermal conductivity than the porous bed are placed in the bed parallel to the flow. The pins, attached to a cooling plate, appear to increase significantly the effective conductivity of the bed. The experiment indicates that optimum uniform moisture deposition is achieved by adjusting the flow rate until the midpoint temperature is within the theoretically allowed variation. (Carr-Arizona)
W70-05594

HYDRAULIC DESCRIPTION OF RECESSION OF SHALLOW FLOW OVER A POROUS BED,
Washington State Univ., Pullman. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02G.
W70-05596

METHOD FOR DETERMINING MINIMUM-COST FARM-IRRIGATION PIPELINE DESIGN,
Soil Conservation Service, Milford, N.H.
David L. Horn.
American Society of Agricultural Engineers, Transactions, Vol 10, No 2, p 209-212, 216, March-April 1967. 5 fig, 6 ref.

Descriptors: *Irrigation design, *Irrigation engineering, *Costs, *Pipelines, *Pipes, Pipe flow, Concrete pipes, Metal pipes, Plastic pipes, Steel pipes, Conveyance structures, Engineering structures, Structures, Conduits, Design, Equations, Farm equipment, Water loss, Water conservation.
Identifiers: *Conservation irrigation, *Cost functions, Diameter, Head conditions.

A procedure is outlined for determining a combination of border width and pipe diameter to achieve conservation irrigation capability at least cost to the farmer. The procedure is simple, but involves many assumptions. It is possible for the assumptions to be altered without difficulty. The method can be applied not only to concrete pipe, but also to pipelines made from steel, plastic, transite, or other material. Such a rational and systematic approach should eliminate much of the trial-and-error guesswork in pipeline design. (Carr-Arizona)
W70-05597

CONTROL STRUCTURES FOR AUTOMATIC SURFACE IRRIGATION SYSTEMS,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center; and Idaho Univ., Moscow. Agricultural Experiment Station.
A. S. Humpherys.
American Society of Agricultural Engineers, Transactions, Vol 10, No 1, p 21-23, 27, January-February 1967. 15 fig, 1 ref.

Descriptors: *Automatic control, *Gate control, *Control structures, *Irrigation efficiency, *Surface irrigation, Irrigation, Irrigation systems, Irrigation design, Irrigation engineering, Engineering structures, Check structures, Equipment, Gates, Ditches, Automation, Border irrigation, Furrow irrigation.

Although automated surface irrigation can save water and money for the irrigator, it is not used on a large scale owing to lack of economical equipment and satisfactory design criteria. Various types of automatic control structures are being developed and tested in an effort to satisfy the requirements of different irrigation systems. Structures are needed for lined and unlined ditches in furrow, graded border, basin, furrow cutback, and recirculating systems. The design and testing of automatic flexible check dams for lined and unlined ditches, metal flap gates for unlined ditches, and metal drop gates for lined ditches are discussed. (Carr-Arizona)
W70-05598

CROP YIELD RESPONSE TO NONUNIFORM APPLICATION OF IRRIGATION WATER,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Dan Zaslavsky, and Nathan Buras.
American Society of Agricultural Engineers, Transactions, Vol 10, No 2, p 196-198, 200, March-April 1967. 4 fig, 6 ref.

Descriptors: *Application methods, *Crop response, *Irrigation effects, *Irrigation efficiency, *Irrigation water, Water injury, Salinity, Drainage effects, Equations, Variability, Model studies, Mathematical models, Moisture, Aeration, Fluctuation, Crop production.
Identifiers: *Fluctuation response index.

Belief that uniform application of irrigation water is necessary in order to obtain maximum crop yield has led to the use of increasing amounts of water in order to insure uniformity of application. However, surplus moisture may appear in some spots and may be harmful in areas of insufficient drainage, poorly aerated soils, or where there is a salinity problem. An analysis is attempted which would relate degree of treatment uniformity to elicited crop response. The analysis utilizes a 'fluctuation response index' that combines the variability of treatment application with the crop yield response. Assuming that treatment levels in a plot fluctuate symmetrically about the means, average yield Y-bar depends on average treatment level Q-sub-O and a correction factor called the fluctuation response index. (Carr-Arizona)
W70-05604

TRANSFER RESTRICTIONS AND MISALLOCATIONS OF IRRIGATION WATER,
Utah State Univ., Logan. Dept. of Agricultural Economics, and Iowa State Univ., Ames. Dept. of Economics.
B. Delworth Gardner, and Herbert H. Fullerton.
American Journal of Agricultural Economics, Vol 50, No 3, p 556-571, August 1968. 3 fig, 3 tab, 18 ref.

Descriptors: *Water transfer, *Water utilization, *Marginal productivity, *Institutional constraints, *Water allocation (Policy), Utah, Efficiencies, Regression analysis, Value, Prices, Variability, Irrigation water.
Identifiers: *Marginal value product, Covariance analysis, Real price.

Legal rules and institutional policies tend to restrict water use to certain classes of users and types of utilization. It is often argued that inefficiency results from such transfer impediments. Since conditions of unrestricted water movement seldom exist, a case in Utah is important as a study. A Utah area allowed four water companies to exchange water freely after a long period in which only intracompany transfers were permitted. Regression analysis was used to study the increase in the marginal value product of water. Transfer policy and water delivered per irrigated acre were statistically significant variables and accounted for 89 percent of the difference in rental price before and after 1948. Covariance analysis indicated that the real price of water increased by $1.84 in the period since 1948. There is no doubt that this was due to the greater flexibility in transfer. (Carr-Arizona)
W70-05605

COMPARISON OF CHEMICAL AND NONCHEMICAL TECHNIQUES FOR SUPPRESSING EVAPORATION FROM SMALL RESERVOIRS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering; and Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03B.
W70-05606

DRIP IRRIGATION - A METHOD USED UNDER ARID AND DESERT CONDITIONS OF HIGH WATER AND SOIL SALINITY,
For primary bibliographic entry see Field 03C.
W70-05607

EFFICIENT BORDER IRRIGATION DESIGN AND OPERATION,
Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch.
O. W. Howe, and D. F. Heermann.
American Society of Agricultural Engineers, Transactions, Vol 13, No 1, p 126-130, January-February 1970. 10 fig, 5 tab, 6 ref.

Descriptors: *Irrigation design, *Irrigation efficiency, *Irrigation operation and maintenance, *Border irrigation, *Design criteria, Irrigation engineering, Irrigation systems, Uniformity coefficient, Runoff, Soil texture, Slopes, Turnouts, Loam, Infiltration.
Identifiers: *Cutoff time, Stream size, Advance-regression curves.

Experiments were conducted on medium-and fine-textured loam soils in order to study the concept of optimum efficiency resulting from uniform intake opportunity times. The information was used to determine design and operation criteria for minimum runoff and maximum uniformity coefficient. The results indicated that for border irrigation under similar conditions uniformity coefficient is independent of input stream size within the 0.03 to 0.12 cfs per ft of border width range. The coefficient is also independent of slope in the low gradient range and for steeper slopes with close growing crops. 3 to 4 inches during the first 2 hours appears to be the minimum application depth for border irrigation that can be applied with high

uniformity and minimum runoff. High uniformity was easier to obtain on the low gradients. Cutoff time was found to be the most crucial variable for efficient irrigation. Automatic turnout controls would be necessary if adaptation of border irrigation practice is accepted. (Carr-Arizona)
W70-05608

ROTATING-BOOM PLOT IRRIGATOR WITH OFFSET MOUNTING,
Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch; and North Dakota State Univ., Fargo. Agricultural Experiment Station.
J. J. Bond, J. F. Power, and H. M. Olson.
American Society of Agricultural Engineers, Transactions, Vol 13, No 1, p 143-144, 147, January-February 1970. 4 fig, 2 tab, 4 ref.

Descriptors: *Research equipment, *Equipment, *Sprinkler irrigation, *Irrigation design, *Irrigation engineering, Sprinkling, Design, Irrigation systems, Irrigation practices, Irrigation efficiency, Rates of application, Nozzles, Orifices, Application methods, Wind velocity.
Identifiers: *Plots, *Offset mounting, *Rotating boom.

An irrigator specifically designed for sprinkler irrigation research is described and its performance discussed. It is concluded that the field plot irrigator in question has numerous advantages over commercially manufactured systems, among them: (1) On-plot traffic is eliminated by the offset mounting. (2) No disassembly is necessary when moving within the experimental area. (3) Even in relatively high winds, water is applied uniformly with minimum spray drift. (4) Amount of water applied is accurately metered. (5) Rate of application can be varied by changes in operating pressure or nozzle orifices. (6) The system can be adjusted for different crop heights. The only disadvantages of the irrigator appear to be its expense and the circular pattern in which the water is applied. (Carr-Arizona)
W70-05610

SPRINKLER INTENSITY AND SOIL TILTH,
Utah State Univ., Logan. Agricultural and Irrigation Engineering Dept.; and Utah Agricultural Experiment Station, Logan.
For primary bibliographic entry see Field 02G.
W70-05611

A STUDY OF INSTITUTIONAL FACTORS AFFECTING WATER RESOURCE DEVELOPMENT IN THE LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 06B.
W70-05641

SOIL TEMPERATURE PROFILES DURING INFILTRATION AND REDISTRIBUTION OF COOL AND WARM IRRIGATION WATER,
California Univ., Davis.
For primary bibliographic entry see Field 02G.
W70-05688

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

GEOMETRIC SHAPING AND CONTOURING OF LAND AS RELATED TO POTENTIAL FOR SURFACE-WATER STORAGE,
Agricultural Research Service, Brookings, S. Dak.; and South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
C. W. Doty, and J. L. Wiersma.
American Society of Agricultural Engineers, Transactions, Vol 12, No 3, p 332-325, 328, May-June 1969. 8 fig, 3 tab, 12 ref.

Descriptors: *Water storage, *Surface runoff, *Erosion control, *Water conservation, *Soil conservation, Terracing, Contour farming, Runoff, South Dakota, Corn Belt, Shape, Storage capacity, Planting management, Crop production.
Identifiers: *Geometric shaping, *Listing, *8-row bedding.

In the Corn Belt 60-75% of annual runoff and 75-90% of annual erosion occurs during the first 60 days of the corn season (planting to second cultivation). Since it is impossible to apply a crop canopy to the soils, surface configurations on the land are necessary to store water and reduce runoff. The study was designed to discover which of six various geometric shapes had the greatest water-holding capacity. This capacity would determine ability to decrease runoff and erosion. It was concluded that listing and 8-row bedding were the most beneficial configurations, provided they were coupled with very accurate contouring. (Carr-Arizona)
W70-05588

HYDROLOGIC EFFECTS OF FLOODWATER-RETARDING STRUCTURES ON GARZA-LITTLE ELM RESERVOIR, TEXAS,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 08A.
W70-05637

PROPERTIES OF TILE DRAINAGE WATER,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 02K.
W70-05642

ORGANIZATION OF DRAINAGE DISTRICTS.

Mo Ann Stat secs 243.080 thru 243.130 (1952).

Descriptors: *Missouri, *Drainage districts, *Ditches, *Legal aspects, Benefits, Drainage, Construction, Assessments, Cost analysis, Cost allocation, Lands, Planning, Maps, Design, Damages, Compensation, Condemantion, Eminent domain, Overflow, Outlets, Legislation, Surveys, Right-of-way.

After the establishment of a drainage district, the county court shall direct the district's engineer, or shall appoint other qualified persons, to file reports determining the location, dimension, and estimated costs of proposed improvements. The report shall contain surveys of the improvements, maps of lands affected, and descriptions of lands necessary to be acquired for rights-of-way. All affected landowners may appear before the viewers and express their opinions concerning the report. Assessment of benefits for improvements shall be limited to those improvements actually constructed. Proper considerations in assessing benefits are outlined. Upon the filing of the report the clerk of the county court shall give notice by publication. The attorney for the drainage district or aggrieved landowners may file exceptions to the report with the county court. The county court has authority to condemn any land needed in connection with the improvements. No district shall enter any lands before compensation is paid to affected landowners. Appeal from county court determinations shall be to the circuit court. The county court has authority to condemn additional land for the district if necessary. (Duss-Florida)
W70-05658

ON THE HIERARCHIAL STRUCTURE OF NATURAL DRAINAGE SYSTEMS,
Hugo E. Mayer, Jr.
Water Resources Research, Vol 6, No 1, p 303-309, February 1970. 7 p, 1 fig, 4 tab, 12 ref.

Descriptors: *Drainage patterns (Geologic), *Tributaries, Drainage density, Geomorphology, Watersheds (Basins), Channel morphology, Geologic control, Streams, Erosion, Mathematical studies, Model studies, Mathematical models.
Identifiers: Bifurcation ratio, Stream length ratio, Basin area ratio, Basin shape.

A relation exists among 4 parameters of natural drainage systems. The parameters are: the bifurcation ratio, the stream length ratio, the basin area ratio, and the stream length ratio raised to a power which is the reciprocal of the basin shape parameter. Bounds for the basin area ratio are determined by exploiting the fact that some streams of order i do not join streams of order i + 1 but join streams of higher order. Those bounds, with given values for the basin-shaped parameter, enable us to determine admissible regions for feasible pairs of values that the bifurcation and stream length ratios may assume. A plot of an admissible region and some associated tables are provided. (Knapp-USGS)
W70-05689

A TECHNIQUE OF GENERATING A SYNTHETIC FLOW RECORD TO ESTIMATE THE VARIABILITY OF DEPENDABLE FLOWS FOR A FIXED RESERVOIR CAPACITY,
North Carolina State Univ., Raleigh; and Virginia Polytechnic Inst., Blacksburg.
For primary bibliographic entry see Field 02E.
W70-05692

A TWO-STAGE OPTIMIZATION MODEL FOR DESIGN OF A MULTIPURPOSE RESERVOIR,
California Univ., Los Angeles; and Chile Univ., Santiago.
For primary bibliographic entry see Field 06A.
W70-05700

ROUTE OR CONVOLUTE,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02A.
W70-05702

LAND TREATMENT IN WATERSHED PROGRAM AREAS,
Agricultural Stabilization and Conservation Service, Washington, D.C. Conservation and Land Use Programs Div.
For primary bibliographic entry see Field 04D.
W70-05706

FLOOD PLAIN INFORMATION OF ANDROSCOGGIN RIVER, AUBURN AND LEWISTON, MAINE.
Army Corps of Engineers, Waltham, Mass. New England Div.

Corps Engineers Flood Plain Report, July 1969. 37 p, 8 fig, 8 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Maine, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Androscoggin River, Auburn (Maine), Lewiston (Maine).

Flooding of the Androscoggin River, Auburn and Lewiston, Maine is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05716

LEVEE DISTRICTS (USE OF LEVEES AS RAILWAY ROADBEDS).

Mo Ann Stat secs 245.405 thru 245.450 (1959).

Descriptors: *Missouri, *Levees, *Engineering structures, *Railroads, Legal aspects, Legislation, Civil engineering, Land management, Flood protection, Flood control, Administrative agencies, Roadbanks, Embankments, Maintenance, Railroad relocation, Construction, Conservation, Right of way.

Levees may be used as railway roadbeds and railway roadbeds may be used as levees pursuant to contracts between the railroad corporations and the board of directors of levee districts. The duties of a railway company when a levee passes along its roadbed or other embankment are set forth. Whenever a railroad passes over or along land subject to overflow by any river or creek and such land is protected by levees, the railroad has a duty to continue and maintain the levee where it approaches and abuts the railroad right of way. Levee inspectors must see that the crossings of all public and private roads are so constructed that the travel and traffic thereon will not endanger the permanency of the levee or cause a break or crevasse in the levee in time of high water. (Powell-Florida)
W70-05773

DRAINAGE AND LEVEE DISTRICTS: GENERAL PROVISIONS (SUBDRAINAGE AND LEVEE DISTRICTS).
Mo Ann Stat secs 246.010 thru 246.067 (1959).

Descriptors: *Missouri, *Drainage districts, *Levees, *Flood control, Legal aspects, Legislation, Flood protection, Barriers, Administration, Governments, Floods, Overflow, Swamps, Land, Construction, Assessments, Taxes, Cities, Local governments, Water resources development, Administrative agencies, Water control, Abatement.

Owners of lands in main drainage and levee districts may, for the purpose of obtaining and providing local or more complete drainage protection, form and administer subdrainage and levee districts. To secure increased protection, lands in main districts may be united with swamp or overflowed lands, either within or without other districts, in the formation of new districts. Procedures are provided for the cancellation or reduction of assessed benefits to lands in a levee or drainage district where subsequent improvements nullify the benefits accruing from previous improvements. When authorized by the vote of owners of two-thirds of the acreage in any drainage or levee district, that district may issue tax anticipation warrants. (Casey-Florida)
W70-05774

DRAINAGE AND LEVEE DISTRICTS: GENERAL PROVISIONS (OBSTRUCTION, IMPAIRMENT OR DESTRUCTION OF WORKS).
Mo Ann Stat secs 246.180 thru 246.270 (1959).

Descriptors: *Missouri, *Drainage districts, *Levees, *Drainage systems, Legal aspects, Legislation, Dams, Dikes, Flood control, Flood protection, Ditches, Drainage, Bridges, Bridge construction, Drains, Banks, Overflow, Land, Natural resources, Cities, Local governments, Taxes, Assessments, Costs, Watercourses (Legal).

No one may sink, set or drive any supports for bridges in any ditch, drain or watercourse constructed by any drainage or levee district. All supports for bridges must be placed on the banks of ditches, drains, and watercourses so as not to obstruct the flow of water. It is unlawful for anyone to obstruct, impair or destroy any drain, levee, ditch, dike, revetment or other work constructed by any drainage or levee district, and anyone who willfully and maliciously does so, with intent to injure or destroy, is guilty of a felony. Landowners and county sheriffs have the duty to report any violations. Penalties are provided for violation of these provisions. The performance of prescribed duties governing the organization and administration of drainage or levee districts may be enforced by mandamus at the instance of anyone interested in the district. If a municipality consents by adopting an ordinance as prescribed, municipal property situated within or outside the city limits may be included within the boundaries of a drainage or levee district. (Casey-Florida)
W70-05786

KAY-NOOJIN DEVELOPMENT CO V HACKETT (LIABILITY FOR COLLECTION AND DISCHARGE OF SURFACE WATERS).
45 So 2d 792-794 (Ala 1950).

Descriptors: *Alabama, *Surface runoff, *Drainage systems, *Relative rights, Judicial decisions, Ditches, Surface waters, Embankments, Natural flow, Water rights, Rain water, Runoff, Channels, Surface drainage, Legal aspects, Damages.

Plaintiff alleged that defendants, developers of a residential area adjacent to his land, had constructed a drainage system which discharged water onto his land in an unnatural and harmful volume. The trial court overruled a demurrer to the complaint and the Supreme Court of Alabama affirmed. The court stated that an upper proprietor may not collect surface water which would naturally spread out over a wide area and cast it upon the premises of a lower proprietor in unnatural volume, rapidity and channel. (Hubener-Florida)
W70-05833

ELAM V CORTINAS (OBSTRUCTIONS TO DRAINAGE).
53 So 2d 146-149 (La 1951).

Descriptors: *Louisiana, *Drainage, *Relative rights, *Obstruction to flow, Culverts, Bayous, Judicial decisions, Streambeds, Ditches, Drainage programs, Navigable waters, Natural watercourses, Non-navigable waters, Relative rights, Highways, Landfills, Land tenure, Legal aspects, Natural flow.
Identifiers: *Injunctions (Prohibitory), Injunctions (Mandatory).

Plaintiff sued for mandatory and prohibitory injunctions against defendant to prevent interference with drainage from plaintiffs land. Defendant had filled in the bed of a dry bayou which prevented the natural drainage from plaintiff's property from flowing through it. Defendant was also allegedly interfering with the drainage of plaintiff's land in the opposite direction by filling in a culvert. The trial court ordered defendant to cease all interference and to remove the fill in the dry bed of the old bayou. The supreme court held that there was no natural drainage through the old bayou, and consequently defendant did not have to remove the fill. However, the court ordered defendant not to fill in or obstruct any drainage through the culvert. (Hubener-Florida)
W70-05834

MASSEY V BRITT (COVENANT RUNNING WITH PROPERTY TO WITHDRAW WATER FROM A SPRING ENFORCED).

164 SE2d 721-722 (Ga 1968).

Descriptors: *Georgia, *Pipes, *Spring waters, *Judicial decisions, Springs, Water table, Pumping, Running waters, Land tenure, Relative rights, Legal aspects, Water rights.
Identifiers: *Injunctions.

The assignee of a grantee of land sued to enjoin the grantor from interfering with his right to obtain water from a spring located on property retained by grantor. The assignee sought to lay pipe across the grantor's land in order to obtain the water. The Supreme Court of Georgia held that under the deed giving grantee the right to get water from the spring located on grantor's property, grantee need not continue to use a bucket and could install a pipe. However, grantee was limited as to the amount of water which he could remove. (Hubener-Florida)
W70-05836

ROTH V GREAT ATLANTIC AND PACIFIC TEA CO, INC (RELATIVE RIGHTS OF ADJACENT LANDOWNERS).

108 F Supp 390-394 (E D NY 1952).

Descriptors: *New York, *Surface runoff, *Drainage, *Repulsion (Legal aspects), Judicial decisions, Legal aspects, Drainage water, Riddance (Legal aspects), Land reclamation, Drains, Construction, Administrative agencies, Regulation, Permits, Administration, State governments, Public health, Landfills, Social aspects, Area redevelopment, Social needs, Third party effects, Social impact.

Plaintiff landowners brought action to recover damages for alleged negligent flooding of their premises and sought an injunction to restrain the defendant from maintaining the conditions which were alleged to have created the flooding. The basis of the owners' claim was that defendant had provided inadequate drainage facilities in constructing a store, and that water which formerly had run off plaintiffs' land, across defendant's vacant land and into the street, no longer could do so. Plaintiffs' alleged defendant was negligent in not foreseeing the flooding. The court found no negligence, basing its decision on a well-established rule of public policy preferring reclamation and improvement of low lands to the imposition of a perpetual drainage servitude in favor of upper proprietors. Lower landowners, may in good faith and for the purpose of building and improving their land, fill or grade such land even though surface water is cast back on the lands above. (Barnett-Florida)
W70-05845

LEVEE AND DRAINAGE DISTRICTS (HIRING OF ENGINEERS AND WATCHMEN; REPAIR OF IMPROVEMENTS).
Iowa Code Ann secs 455.180-455.183 (1949).

Descriptors: *Iowa, *Drainage districts, *Engineering personnel, *Levees, Drainage programs, Local governments, Legislation, Boundaries (Property), Surface drainage, Surface runoff, Assessments, Swamps, Jurisdiction, Watercourses (Legal), Costs, Repairing, Financing, Legal aspects, Ditches.

The board of a county into which a levee or drainage improvement extends shall employ a competent engineer to inspect such levees or drainage improvements and to report on their condition and need of improvement. The board shall also employ watchmen to watch levees and make necessary repairs on them. This chapter shall be construed to promote proper drainage, leveeing, ditching, and reclamation of swamp and overflow lands. The collection of taxes by the board of a county shall not be impeded on account of irregularities in any proceedings before the establishment of the drainage district. Provision is made for payment of costs. (Hubener-Florida)
W70-05847

CONSOLIDATION OF DISTRICTS, SUBDISTRICTS AND MINOR SUBDISTRICTS.
Ill Ann Stat ch 42, secs 9-1 thru 9-9 (Smith-Hurd 1956), as amended, (Supp 1970).

Descriptors: *Illinois, *Drainage districts, *Local governments, *Drainage systems, Legislation, Judicial decisions, Boundaries (Property), Drainage programs, Regions, Legal aspects, Administration, Assessments, Administrative agencies, Leadership, Political aspects.
Identifiers: *Consolidation.

Any two or more adjoining drainage or levee districts may merge and form a single consolidated district. 'Adjoining' means that the boundaries of the districts are contiguous or overlapping at some point. The county court in the county containing the greater share of the land may approve the merger after an election or a petition signed by a requisite number of adults owning land in the districts. The court must also determine that such a consolidation will be beneficial to the major portion of land in each district. The consolidated district shall succeed to all the records, property, funds, rights and duties of the former districts. Provisions govern the effect of consolidation upon assessments and indebtedness of the merged districts. Upon consolidation the duties of commissioners and other officers of each merged district shall cease and new commissioners appointed. (Hubener-Florida)
W70-05848

HIGHWAY DRAINAGE DISTRICTS.

Iowa Code Ann secs 460.1-460.13 (1949).

Descriptors: *Iowa, *Highways, *Drainage districts, *Local governments, Legislation, Condemnation, Right-of-way, Assessments, Boundaries (Property), Levees, Trees, Orchards, Eminent domain, Ditches, Water control, Flood control, Soil erosion, Drainage programs, Jurisdiction, Legal aspects, Administrative agencies, Costs, Financing.

When it is necessary to drain any part of a highway, a highway drainage district may be established by county boards of supervisors. Such district shall have all the powers granted to drainage and levee districts. Improvements are to be financed out of primary and secondary road maintenance funds and assessments against real estate. The board of supervisors of the county may acquire rights-of-way by condemnation proceedings. Ornamental trees adjacent to dwellings, orchard trees, and trees used as windbreaks may not be destroyed in making the drainage improvements. The right to remove other trees and hedges may be acquired through eminent domain. (Hubener-Florida)
W70-05849

CONVERTING INTRACOUNTY DISTRICTS INTO INTERCOUNTY DISTRICTS (DRAINAGE DISTRICTS).
Iowa Code Ann secs 458.1-458.5 (1949).

Descriptors: *Iowa, *Drainage districts, *Local governments, *Administrative agencies, Legislation, Assessments, Boundaries (Property), Levees, Ditches, Water control, Drainage programs, Jurisdiction, Watercourses (Legal), Surface drainage, Land use, Drainage effects, Flood control, Soil erosion, Legal aspects, Coordination, Land tenure.

When a ditch, drain, or natural watercourse in one county is the common carrying outlet for one or more drainage districts in the other county, the boards of supervisors of the counties may establish intercounty drainage districts. No land may be included in such drainage district unless it receives special benefits from the improvements in the proposed intercounty district. Any affected landowner may appeal the action of the joint boards in establishing the new district to the district court of the county where his land lies. (Hubener-Florida)
W70-05850

LEVEE AND DRAINAGE DISTRICTS (DISTRICTS FORMED BY MUTUAL AGREEMENT OF LANDOWNERS; OUTLETS).
Iowa Code Ann secs 455.151-455.157 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Drainage districts, *Levees, *Outlets, Drainage programs, Local governments, Legislation, Eminent domain, Right-of-way, Boundaries (Property), Settling basins, Ditches, Public health, Watercourses (Legal), Surface drainage, Surface runoff, Assessments, Taxes, Jurisdiction, Legal aspects, Drainage systems, Coordination, Administration, Land tenure.

Owners of land lying wholly within one county may provide for the combined drainage of their lands by mutual agreement. Such agreement shall contain a description of the land, the location of drains, settling basins, and ditches to be constructed, the character and extent of the drainage, and the assessment of any damages. The board of supervisors of the county shall carry out the object of the agreement and shall levy taxes against the lands of the drainage district. The board may purchase a right-of-way in an adjoining county to be used as a drainage outlet, and it may exercise the power of eminent domain in the adjoining county. The board may also purchase a right-of-way in an adjoining state. (Hubener-Florida)
W70-05851

LEVEE AND DRAINAGE DISTRICTS.
Iowa Code Ann secs 455.1-455.9 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Levees, *Drainage districts, *Ditches, Drainage, Drains, Artificial watercourses, Natural streams, Settling basins, Public health, Agricultural watersheds, Missouri River, River training, Bank protection, Bank erosion, Erosion control, Embankments, Overflow, Bank stabilization, Administrative agencies, Drainage patterns (Geologic), Railroads, Legal aspects, Political aspects.
Identifiers: *Petitions.

The board of supervisors of any county may: establish drainage districts; construct levees, ditches, drains, watercourses, or settling basins; and straighten, widen, deepen, or otherwise change any natural watercourse in such county. The drainage or protection of agricultural lands is presumed to be a public benefit. The word levee is defined to include any construction necessary to protect the banks of any river from wash, cutting, or erosion. All levees, ditches, or drains, so far as practicable and economical, should follow the general course of natural streams or the general course of natural drainage. Whenever any ditch or drain must cross a railroad right-of-way, it should cross at the place of the natural waterway or at such other place as provided by the railroad. Levee or drainage districts may be established upon petition by the owners of 25 percent of the land affected by the proposed district. If the proposed district involves only the straightening of a stream, 35 percent of the above-mentioned owners must petition using the prescribed form for a petition. (Dearing-Florida)
W70-05852

DRAINAGE DENSITY IN DRIFT-COVERED BASINS,
Washington State Univ., Pullman. Dept. of Engineering.
For primary bibliographic entry see Field 2E.
W70-05884

4B. Groundwater Management

NITRATE ACCUMULATION IN KANSAS GROUNDWATER,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 05B.
W70-05644

PRELIMINARY RESULTS OF HYDROLOGIC STUDIES AT TWO RECHARGE BASINS ON LONG ISLAND, NEW YORK,
Geological Survey, Washington, D.C.
G. E. Seaburn.
Geological Survey Professional Paper 627-C, p C1-C17, 1970. 17 p, 15 fig, 4 tab, 13 ref, append.

Descriptors: *Pit recharge, *Storm runoff, *Cities, *New York, Artificial recharge, Water table, Infiltration, Permeability, Water management (Applied), Water reuse, Urbanization, Hydrographs.
Identifiers: Long Island (NY).

More than 2,000 recharge basins on Long Island are used to dispose of storm runoff from residential and industrial areas and highways. Two of these basins have been instrumented to measure the response time of runoff generated from a rainfall event and to study inflow patterns and the infiltration rates of the selected basins. The time lag recorded at the Westbury test basin from the start of rainfall to the start of inflow ranged from 5 to 20 minutes. The time lag from the start of rainfall to the initial rise in the water table was between 2 and 8 hours. The average ratio of storm-water inflow to rainfall closely approximates the ratio of paved street area to total drainage area of both basins. The estimated average annual volume of groundwater recharge in 1967 was 7.5 acre-feet for the Westbury recharge basin and 10 acre-feet for the Syosset recharge basin. The average infiltration rate at the Westbury recharge basin for 12 storms during the summer and fall of 1967 was 211 gallons per day per square foot. (Knapp-USGS)
W70-05711

THE METHODS OF STUDYING THE FREE UNCONFINED GROUNDWATER REGIME IN IRRIGATION REGIONS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
D. M. Katz.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 262-268, 1968. 7 p, 2 tab, 3 ref.

Descriptors: *Irrigated land, *Observation wells, *Groundwater recharge, *Methodology, Network design, Regional analysis, Water balance, Salt balance, Aeration, Evaporation, Transpiration, Precipitation (Atmospheric), Convection, Diffusion.
Identifiers: *USSR, Groundwater salinity.

In the USSR, three types of observation networks are used to solve groundwater problems. These types are: regional network, network within a farming area, and special temporary network. Knowledge of the water and salt balance are necessary to quantitatively estimate the groundwater recharge and discharge as well as groundwater salinity. The hydrochemical regime of groundwater is a result of the following process: (1) Enrichment with salts which are leached from the zone of aeration; (2) concentration of salts by evaporation and transpiration; (3) precipitation of salts as a result of change in concentration and other processes; (4) convective and molecular diffusion and exchange reactions. (Carstea-USGS)
W70-05731

METHODS OF STUDY OF THE GROUNDWATER BUDGET IN NORTH AMERICA,
For primary bibliographic entry see Field 02F.
W70-05733

GEOLOGY, HYDROLOGY, AND QUALITY OF WATER IN THE HANFORD-VISALIA AREA, SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02F.
W70-05737

INJECTION OF RECLAIMED WASTEWATER INTO CONFINED AQUIFERS,
Toups Engineering, Inc., Santa Ana, Calif.; and Orange County Water District, Santa Ana, Calif.
For primary bibliographic entry see Field 05D.
W70-05880

4C. Effects on Water of Man's Non-Water Activities

URBAN STORM RUNOFF RELATIONS,
Nebraska Univ., Lincoln; Public Health Service, Denver, Colo.; and Maine Univ., Orono.
Warren Viessman, Jr., Walter R. Keating, and Kalkunte N. Srinivasa.
Water Resources Research, Vol 6, No 1, p 275-279, February 1970. 5 p, 3 fig, 1 tab, 7 ref.

Descriptors: *Storm runoff, *Rainfall-runoff relationships, *Cities, *Peak discharge, *Mathematical models, Water storage, Infiltration, Routing, Unit hydrographs, Hydrograph analysis, Computer programs, Runoff forecasting.
Identifiers: Urban hydrology.

A model incorporating the hydrologic and hydraulic phases of storm water flows to estimate the runoff from a 23-acre residential area has prediction errors that are generally less than 10% when the peak flow is used as the criterion for comparison. The runoff process of the Gray Haven area, Baltimore is simulated by a linear reservoir, linear channel model. A sequence of 1-minute effective rainfall intensities serves as the input. The effective precipitation is computed directly from the gaged storm pattern by applying one of the loss functions. Depression storage and infiltration are considered to be the primary loss components of the Gray Haven area. The findings point out that a separate consideration of pervious and impervious surfaces in runoff computations for relatively small urban areas might be important. (Knapp-USGS)
W70-05684

PRELIMINARY RESULTS OF HYDROLOGIC STUDIES AT TWO RECHARGE BASINS ON LONG ISLAND, NEW YORK,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-05711

EFFECTS OF URBAN DEVELOPMENT ON DIRECT RUNOFF TO EAST MEADOW BROOK, NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Washington, D.C.
G. E. Seaburn.
Geological Survey Professional Paper 627-B, p B1-B14, 1970. 14 p, 5 fig, 1 plate, 8 tab, 18 ref.

Descriptors: *Rainfall-runoff relationships, *New York, *Urbanization, *Storm runoff, Storm drains, Unit hydrographs, Duration curves, Hydrographs, Hydrology.
Identifiers: Nassau County (NY), Long Island (NY), Urban hydrology.

The effects of intensive urban development on direct runoff to East Meadow Brook, a southward-flowing stream in central Nassau County, N. Y., during the period 1937-66, are described. The special objectives of the study were to relate indices of urban development to increases in the volume of annual direct runoff to the stream; to compare hydrograph features at different periods during the transition of the drainage basin from rural to urban conditions; and to compare the rainfall-runoff relations for periods before and after urban development. Periods of housing and street construction in the drainage basin correspond to 3 distinct periods of increased direct runoff. During each period, the average annual direct runoff increased because of an increase in the area served by storm sewers that discharged into East Meadow Brook. The amount of land served by sewers increased from about 570 acres in 1943 to about 3,600 acres in 1962, or about 530 percent. During this same period, the average annual direct runoff increased from about 920 acre-feet per year to about 3,400 acre-feet per year, or about 270 percent. (Knapp-USGS)
W70-05712

UTILIZATION OF MARGINAL LANDS FOR URBAN DEVELOPMENT,
Partner, Mueser, Rutledge, Wentworth and Johnston, New York.
For primary bibliographic entry see Field 08D.
W70-05881

REAL-TIME COMPUTER CONTROL OF URBAN RUNOFF,
Minneapolis-St. Paul Sanitary District, St. Paul, Minn.
For primary bibliographic entry see Field 07C.
W70-05882

4D. Watershed Protection

LAND TREATMENT IN WATERSHED PROGRAM AREAS,
Agricultural Stabilization and Conservation Service, Washington, D.C. Conservation and Land Use Programs Div.
Earnest L. Gambell.
Water Resources Bulletin, Vol 6, No 1, p 15-22, January-February 1970. 8 p, 2 tab, 3 ref.

Descriptors: *Land management, *Watershed management, *Small watersheds, Planning, Cultivated lands, Erosion control, Farm ponds, Flood control, Soil management, Water conservation, Water management (Applied).
Identifiers: *Watershed planning.

Several types of watershed program areas, principally but not solely those operated under authority of the Watershed Protection and Flood Prevention Act, are greatly altering the American landscape. While structural measures tend to be the most visible feature of these watersheds, land treatment measures (soil, water, woodland, and wildlife conservation practices) are basic to the long term stability and maximum contributions of these watershed programs. Under the land use and management policies of this country, the farm owners and operators in these watersheds have the primary responsibility for land treatment and conservation. In practice, farmer interest and action are largely stimulated and sustained as a result of the operation of functional leaders of farmer-public conservation partnership programs. Examples include locally elected agricultural stabilization and conservation committees, soil and water conservation district supervisors, and watershed program sponsors. (Knapp-USGS)
W70-05706

CONSERVATION--SOIL AND WATER--DEFINITIONS, SUBDISTRICTS.

Mo Ann Stat secs 278.070 thru 278.290 (Legis Service No 2 1969).

Descriptors: *Missouri, *Water conservation, *Administrative agencies, *Water districts, Administration, Water law, Water management, Water policy, Water supply, Governments, Legal aspects, Administrative decisions, Legislation, Local governments, State governments, Institutions, Water conservation, Planning, Political aspects, Leadership, Taxes, Cities, Coordination, Federal government.

Subdistricts of soil and water conservation districts may be formed on petition of the landowners of such districts. Land already in one subdistrict may not be included within another. Soil and water commissioners shall determine whether operation of a subdistrict is feasible and submit the question to landowners for referendum. The board of soil and water conservation supervisors of the district within which the subdistrict is formed shall govern the subdistrict. Three persons within the subdistrict shall be elected its trustees by a majority of the landowners participating in the referendum. The trustees shall: (1) act as an executive committee for the subdistrict; (2) recommend tax levies to the governing body; (3) secure land rights; and (4) arrange for inspection and maintenance of completed works or improvements. After a subdistrict has existed for five years without constructing works or improvements, landowners by referendum may disestablish the subdistrict. Two or more subdistricts may be consolidated on vote of landowners. Water conservation units may, as provided herein, cooperate with the federal government. The terms board of soil and water district supervisors, land representative, conservation district, soil and water districts commission, township, and landowner are defined. (Dye-Florida)
W70-05885

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

FREE AMINO ACIDS AND RELATED SUBSTANCES IN MARINE ORGANISMS,
City of Hope Medical Center, Duarte, Calif.
For primary bibliographic entry see Field 05C.
W70-05631

QUANTITATIVE MICRO-DETERMINATION OF LIPID CARBON IN MICROORGANISMS,
California Univ., San Diego, La Jolla. Inst. of Marine Resources; and Scripps Institution of Oceanography, La Jolla, Calif. Div. of Marine Biology.
For primary bibliographic entry see Field 07B.
W70-05651

BIOASSAY OF SEAWATER. IV. THE DETERMINATION OF DISSOLVED BIOTIN IN SEAWATER USING C-14 UPTAKE BY CELLS OF AMPHIDINIUM CARTERI,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
A. F. Carlucci, and S. B. Silbernagel.
Canadian Journal of Microbiology, Vol 3, p 979-986, 1967. 2 fig, 3 tab, 11 ref.

Descriptors: *Bioassay, *Sea water, *Vitamins, Vitamin B, Algae, Cultures, Chemical analysis, Analytical techniques, Dinoflagellates, Marine bacteria, Water chemistry, Carbon radioisotopes, Pacific Ocean, Carbon dioxide, Light, Temperature.
Identifiers: *Biotin, *Amphidinium carteri, *Radiocarbon uptake techniques, Water pollution identification, Organic solutes, Vitamin B-1, Vitamin B-12, Thiamine, Serratia marinorubra, Gyrodinium cohnii, Microbial ecology, Coulter counter, Growth inhibition, Cyanocobalamin, Mutant bacteria, Cyclotella nana, Geiger counter.

Three vitamins of potential importance in marine microbial ecology are biotin, cyanocobalamin (B-12), and thiamine (B-1). Mutant marine bacteria and heterotrophic dinoflagellates have been employed in bioassays to estimate biotin previously, but such assays have been relatively insensitive. Biotin dissolved in seawater can be determined by rapid, sensitive, and precise technique described. Uptake of radiocarbon-labeled carbon dioxide cells of the marine dinoflagellate, Amphidinium carteri, during 2 hours following 94 hours of preincubation under carefully controlled conditions is proportional to biotin concentration. Cells can be enumerated in hemacytometer or with electronic particle counter to evaluate growth responses of dinoflagellate populations to vitamin concentrations, but incubation must be extended to 144 or 168 hours to obtain proportional dose-response curves. Biotin can be assayed in range of concentrations, 0.2-6.0 nanograms/liter, a sensitivity considerably greater than those for microbiological assays previously described. Six replicated determinations at 1 and 3 nanograms/liter yielded standard deviations of 0.09 and 0.28 respectivly. From the north Pacific Ocean, 45 samples contained biotin in concentration range, 0.65-3.0 nano-

grams/liter. Availability of techniques for assay of ecologically important concentrations of vitamins makes possible a study of their role in marine environments. (Eichhorn-Wisconsin)
W70-05652

INFLUENCE OF METHOD FOR REMOVAL OF SESTON ON THE DISSOLVED ORGANIC MATTER. II. COBALAMINS,
Washington Univ., St Louis, Mo. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W70-05656

MICROBIOLOGICAL ANALYSIS OF WATER.
Millipore Corp., Bedford, Mass.

Millipore Corporation Application Report AR-81, 1969. 25 p, 37 fig, 5 ref.

Descriptors: *Water analysis, *Filtration, *Membrane processes, Coliforms, Aquatic microbiology, Aquatic microorganisms, Water quality, Enteric bacteria, Pathogenic bacteria, Sewage bacteria, Iron bacteria.
Identifiers: Membrane filters.

Membrane filter methods for microbial analysis of water samples are described. The use of membrane filters for isolating and identifying coliform and other bacterial organisms is now well established. In many state and federal laboratories it is the preferred method owing to its simplicity, sensitivity and the fact that the MPN method requires about four times as long. In many cases, the membrane filter method has made it possible to substitute field testing for laboratory analysis. Investigators have used it to isolate pathogenic bacteria for identification purposes when outbreaks of enteric illness were traced to water supply. Detailed in this application report are a variety of specific techniques for isolating and identifying bacterial organisms in raw and treated water, swimming pools, treated sewage and industrial process, rinse and cooling water. (Knapp-USGS)
W70-05722

AN AUTOMATED SYSTEM FOR THE DETERMINATION OF CHEMICAL OXYGEN DEMAND,
Upper Tame Main Drainage Authority, Birmingham (England).
A. E. Hey, A. Green, and N. Harkness.
Water Research, Vol 3, p 873-886, 1969. 4 fig, 5 tab, 6 ref.

Descriptors: *Chemical oxygen demand, *Measurement, *Sewage effluents, Analytical techniques, Automation, Colorimetry, Instrumentation.
Identifiers: Dichromate reduction, Automated apparatus.

Although equipment for automated determination of chemical oxygen demand (COD) is now commercially available, it is not suitable for a continuous analysis of effluents. The described procedure comprises metering of volume samples digested with mercuric sulfate, potassium dichromate, and sulfuric acid in mixture pots. The solution is pumped through a 40 foot glass coil suspended in a fluidized sand bath heated to 160C. The cooled solution is passed through a colorimeter which records the reduction of dichromate. The COD is computed by reference to the peak heights given by standards. The modification of the method eliminates the peristaltic pump, an item responsible for frequent breakdown of the assembly. (Wilde-Wisconsin)
W70-05762

THE REAL NATURE OF THE STREETER-PHELPS TEMPERATURE COEFFICIENT,
Washington Univ., Seattle.
Arthur A. Benedict, and Dale H. Carlson.
Water and Sewage Works, Vol 117, No 2, p54-57, February 1970. 2 fig, 2 tab, 5 ref.

Descriptors: *Self-purification, *Temperature effects, *Thermal properties, Biodegradation, Biochemical oxygen demand, Water pollution, Water properties, Energy conversion, Sewage treatment, Waste assimilative capacity.
Identifiers: Streeter-Phelps thermal coefficients.

Comparison of van't Hoff temperature relationship for the temperature reaction rate constant with the Streeter-Phelps temperature coefficient was done with the following conclusions: The temperature coefficient theta associated with the Streeter-Phelps equation can be interpreted in terms of theoretical van't Hoff relationship. However, calculations based on the van't Hoff expression show that theta is a decreasing function of temperature. If a value independent of temperature is applied, the error connected with this assumption for most engineering work is less than 10%. In cases where precise results can be readily obtained, this error may not be acceptable and the approximate nature of the Streeter-Phelps equation should be recognized, and the applicability of this formulation should be tested using the fundamental van't Hoff equation as a base. (Novotny-Vanderbilt)
W70-05782

NEW CORRELATIONS AND TABLES OF THE COEFFICIENT OF VISCOSITY OF WATER AND STEAM UP TO 1000 BAR AND 1000 DEG C,
Glasgow Univ. (Scotland).
For primary bibliographic entry see Field 07C.
W70-05783

TREATMENT OF TEXTILE WASTE LIQUORS,
For primary bibliographic entry see Field 05D.
W70-05863

COMPARISON OF DETERMINATION OF ORGANIC COMPOUNDS IN RETTING WASTE WATERS BY CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND METHODS (IN POLISH),
Jacek Mackowiak.
Instytut Wlokien Lykowych, Prace Vol. 12, p 141-152 1965.

Descriptors: *Chemical oxygen demand, *Biochemical oxygen demand, *Dichromate, *Analytical techniques, Test procedures.
Identifiers: *Flax retting wastes.

In order to find the most appropriate method for determining the COD of flax retting waste waters and its correlation with BOD as determined by the dilution method, experiments were carried out on determination of COD of pure compounds contained in the waste waters and of the waste water themselves. Among chemical methods, the dichromate standard method involving Ag2SO4 as catalyst gave most satisfactory results. Statistical treatment of results led to a correlation formula between BOD and COD in the form: $y = 0.6386x$, where y is BOD in mg. 0/l and x is COD in mg. 0/l. C (1-) ions in concentrations found in flax retting waste waters have no influence on the determination of COD by the standard dichromate method. (Livengood and Mattox-North Carolina State University)
W70-05873

TREATMENT OF WASTE WATERS FROM THE WOOL INDUSTRY (IN RUSSIAN),
For primary bibliographic entry see Field 5D.
W70-05875

5B. Sources of Pollution

QUALITY AND SIGNIFICANCE OF IRRIGATION RETURN FLOW,
Washington Univ., Seattle. Dept. of Civil Engineering; and Washington Univ., Seattle. Dept. of General Engineering.
For primary bibliographic entry see Field 03F.
W70-05563

MINE WATER RESEARCH: CATALIC OXIDATION OF FERROUS IRON IN ACID MINE WATER BY ACTIVATED CARBON,
Bureau of Mines, Washington, D.C.
Edward A. Mihok.
Available from the Clearinghouse as PB-188 645, $3.00 in paper copy, $0.65 in microfiche. Report of investigations, RI-7337, December, 1969. 11 p.

Descriptors: *Acid mine water, Mine drainage, Mine wastes, *Water pollution sources, *Mining engineering, Oxidation, Acids, Catalysts, Carbon.
Identifiers: *Activated carbon treatment, Water treatment.

Laboratory batch-flow tests conducted on a highly ferruginous acid mine water with an activated carbon showed that ferrous iron is rapidly oxidized. This indicates that air oxidation of ferruginous acid in mine waters is catalyzed by activated carbon. The ferrous iron content of an acid mine water flowing through an aspirated activated carbon column was reduced from about 700 to about 10 parts per million in less than 1 minute. Highly efficient ferrous iron oxidation was achieved by conditioning the activated carbon by repeated treatment with acid mine water and air. The reaction proceeds rapidly in the acid environment (pH about 2.5) engendered by ferrous iron oxidation. The activated carbon was used repeatedly with little loss in efficiency, no discoloration, or solids deposition. In these batch tests, about one-third of the iron was adsorbed by the carbon, but with continuous flow, little iron adsorption is expected. Incorporating a catalytic oxidation step in the treatment of acid mine waters containing ferrous iron would greatly facilitate neutralization--precise control of pH, lower reagent costs, elimination of aeration equipment, and smaller holding ponds.
W70-05623

NITRATE ACCUMULATION IN KANSAS GROUNDWATER,
Kansas Water Resources Research Inst., Manhattan.
Larry S. Murphy, and Jay W. Gosch.
Available from the Clearinghouse as PB-191 066, $3.00 in paper copy, $0.65 in microfiche. Project Completion Report, March 1970. 56 p, 13 tab, 19 fig, 38 ref. OWRR Project A-016-KAN.

Descriptors: *Nitrates, *Groundwater, Fertilization, Irrigation, Nitrogen, Farm wastes, Fertilizers, Ammonium compounds, Water pollution sources.
Identifiers: *Nitrate movement, Feedlots.

A study of nitrate-nitrogen accumulation in soils underlying feedlots in Kansas revealed accumulations of as high as 5000 kg/ha in a 4 meter soil profile. Age of the feedlots was found to be directly related to the amount of nitrate-nitrogen which had accumulated in the soil. Vertical movement of nitrate-nitrogen in feedlot soils had occurred even in areas of low rainfall (40-45 cm per annum). Large accumulations of ammonium-nitrogen but no nitrate-nitrogen were noted in a feedlot soil with a very low cation exchange capacity. Analyses of groundwater at that location were inconclusive in relating lack of nitrate-nitrogen in the soil profile with higher levels of nitrate-nitrogen in shallow aquifers. An investigation of the effects of high rates of applied inorganic nitrogen on nitrate-nitrogen accumulations in soil and groundwater was conducted azt two locations. Downward movement of nitrate-nitrogen under irrigated conditions was detected by deep soil sampling (5-6 meters) and comparisons of nitrate-nitrogen concentration peaks in the soil profile. Much variation in the amount of nitrate-nitrogen in the soil profile was noted even with uniform rates of nitrogen application. Investigation of nitrate-nitrogen accumulation in groundwater by means of check wells in the areas receiving large amounts of inorganic nitrogen revealed large fluctuations in the nitrate-nitrogen content over the life of the study but did not produce indications of definite trends. (McKenna-Kansas)
W70-05644

TRITIUM RAINOUT IN THE UNITED STATES DURING 1966, 1967, AND 1968,
Massachusetts Univ., Amherst; and Geological Survey, Washington, D.C.
G. L. Stewart, and T. A. Wyerman.
Water Resources Research, Vol 6, No 1, p 77-87, February 1970. 11 p, 4 fig, 5 tab, 7 ref.

Descriptors: *Fallout, *Rainfall, *Tritium, *United States, Nuclear explosions, Precipitation (Atmospheric), Hydrologic cycle, Hydrologic budget, Tracers, Tracking techniques, Data collections, Radioactivity techniques, Tagging, Surveys.
Identifiers: Tritium rainout.

Annual weighted average tritium concentration and total tritium rainout for United States precipitation continued to decline during 1966 1967, and 1968. Arithmetic mean weighted average tritium concentration for 12 network stations decreased about 38% in 1966 compared to 1965; about 35% in 1967 compared to 1966; and about 30% in 1968 compared to 1967. The 1966, 1967, and 1968 values were only 20%, 13%, and 9% respectively, as great as they were in 1963. Tritium data for special samples collected following the Chinese nuclear bomb test on May 9, 1966, and June 17, 1967, indicate that no measureable tritium was added to United States precipitation as a result of these nuclear explosions. Tritium data are presented in both tabular form and on contoured United States maps in order that estimates of the tritium input function from precipitation to hydrologic systems can easily be made. (Knapp-USGS)
W70-05670

ACCUMULATION OF RADIONUCLIDES IN BED SEDIMENTS OF THE COLUMBIA RIVER BETWEEN THE HANFORD REACTORS AND McNARY DAM,
Battelle Memorial Inst., Richland, Wash., and Geological Survey. Portland, Oreg.
Jack L. Nelson, and W. L. Haushild.
Water Resources Research, Vol 6, No 1, p 130-137, February 1970. 8 p, 6 fig, 2 tab, 12 ref. Contract AT (45-1)-1830 AEC.

Descriptors: *Radioisotopes, *Bottom sediments, *Columbia River, *Washington, *Path of pollutants, Sediment transport, Adsorption, Particle size, Particle shape, Deposition (Sediments), Sediment discharge, Sediment load, Tracers, Tracking techniques.
Identifiers: Hanford (Wash), Pasco (Wash).

Amounts of radionuclides from the Hanford reactors contained in bed sediments of the Columbia River were estimated by two methods: (1) from data on radionuclide concentration for the bed sediments between the reactors and McNary Dam, and (2) from data on radionuclide discharge for river stations at Pasco, Washington, and Umatilla, Oregon. Umatilla is 3.2 kilometers below McNary Dam. Accumulations of radionuclides in the Pasco to Umatilla reach estimated by the 2 methods agree within about 8%. In October 1965 approximately 16,000 curies of gamma emitting radionuclides were resident in bed sediments of the river between the Hanford reactors and McNary Dam. Concentrations and accumulations of chromium-51, zinc-65, cobalt-60, manganese-54, and scandium-46 generally are much higher near McNary Dam than they are in the vicinity of the reactors. These changes are caused by an increase downstream from the reactors in the proportion of the bed sediment that is fine-grained and the proportions of the transported zinc, cobalt, manganese, and scandium radionuclides associated with sediment particles. (Knapp-USGS)
W70-05675

SEDIMENT IN RELATION TO WATER QUALITY,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
E. H. Grissinger, and L. L. McDowell.
Water Resources Bulletin, Vol 6, No 1, p 7-14, January-February 1970. 8 p, 45 ref.

Descriptors: *Water quality, *Sediments, *Water chemistry, *Path of pollutants, Ion exchange, Clay minerals, Particle size, Suspended load, Turbidity, Sediment yield, Sediment load, Erosion, Colloids, Sorption, Sediment transport, Diffusion, Mass transfer.
Identifiers: *Sediment-water quality relations.

The relation between sediment and water quality involves the individual relations between sediment and the physical, chemical, and biological characteristics of water as these characteristics determine the suitability of water for an intended use. Both the physical and chemical properties of fine-grained sediments must be considered in evaluating these relations, whereas only the physical properties of coarse-grained sediments are significant. Most of the literature concerning this subject has considered sediment only as a physical entity. In amount, it is the prime pollutant and is one of the major considerations in evaluating the suitability of water for an intended use. Losses in the United States from sediment and associated flood water damages are measured in billions of dollars annually. Sediments also indirectly affect water suitability through their physical influences on biological activity. Fine-grained sediments, that is, clay minerals and amorphous and organic materials, have chemically active surfaces. These sediments may either sorb ions from solution or release ions to solution depending upon the chemical environment. The ternary system--sediment-water-dissolved chemical load--was studied to define its influence on the biological characteristics of water and the suitability of water for various long-term uses. (Knapp-USGS)
W70-05705

WOOL PROCESSING AND STREAM POLLUTION,
J. W. Masselli, N. W. Masselli, and M. G. Burford.
Textile Industries, Vol. 125, p 121, 128, 132, 137, and 142-144, 1961.

Descriptors: *Water pollution, Detergents, Soaps.
Identifiers: *Wool scouring wastes, *Solvent recovery, *Chemical substitution, Wool, Wool grease, Suint, Carding oil, Acetic acid, Sulfuric acid, Ammonium sulfate.

It is shown that natural impurities extracted from the wool (wool grease and suint), soap, carding oils and acetic acid produce practically all of the BOD from the wool industry. The natural impurities may be removed through solvent recovery and soap may be replaced by low BOD detergent or sulfuric acid. Acetic acid may be replaced by ammonium sulfate and low-BOD carding oils may replace the high-BOD oils usually used. These changes can reduce BOD loads by 60 to 90%. (Mattox and Livengood-North Carolina State Univ)
W70-05866

ARSENIC IN DETERGENTS: POSSIBLE DANGER AND POLLUTION HAZARD,
Kansas State Geological Survey, Lawrence; and Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05F.
W70-05894

5C. Effects of Pollution

EFFECT OF LIGHT INTENSITY AND THICKNESS OF CULTURE SOLUTION ON OXYGEN PRODUCTION BY ALGAE,
Naval Research Laboratory, Washington, D.C. Chemistry Div.
For primary bibliographic entry see Field 02K.
W70-05547

SWIMMER'S ITCH,
Wisconsin Univ., Madison. Dept. of Botany; and Wisconsin Univ., Madison. Dept. of Zoology.
Gerald F. Levy, and John William Folstad.
Environment, Vol 11, No 10, p 14-21, 1969. 5 fig, 1 tab.

Descriptors: *Human diseases, Hosts, Infection, Water pollution effects, Lakes, Rivers, Swimming, Snails, Waterfowl, Birds, Muskrats, Deer, Michigan, Copper sulfate, Wisconsin, Chemcontrol.
Identifiers: *Cercariae, *Schistosome dermatitis, Mice, Green Bay (Wis), Flatworms, Blood flukes, Aquatic snails, Swimmer's itch, Bayluscide, Schistosomiasis.

Swimmers in many northern lakes from coast to coast as well as the extreme south have developed Schistosome dermatitis, a non-debilitating skin disease caused by blood fluke cercariae, which while searching for a bird, snail, or mammal host accidentally penetrate the swimmer's skin, although man cannot act as a host. The disease is spreading due to eutrophication of waters which provides an enhanced environment for aquatic plants supporting the intermediate snail hosts and the cercariae. Copper sulphate and copper carbonate have been used to eradicate the snails but results are temporary and have induced undesirable side-effects such as the mortality of clams, which compete with the snail for food, and fishkills due to asphyxiation because the decaying vegetable matter, killed by the copper salts, reduces dissolved oxygen concentrations. Copper compound treatment may also produce more noxious forms of algae. Safer, although costlier compounds such as Balyscide, are being tried. Non-chemical measures, such as the introduction of cercariae resistant snails to prey on those infected or compete with them for food are under experiment. A continuing comprehensive research program is required to fill present gaps in information on the disease-causing parasite. (Powers-Wisconsin)
W70-05549

EUTROPHICATION TRENDS IN A CHAIN OF ARTIFICIAL LAKES IN MADRAS (INDIA),
Hydrological Research Station, Kilpauk (India).
For primary bibliographic entry see Field 02H.
W70-05550

BIOLOGICAL INTERACTION BETWEEN PLASTICIZERS AND INSECTICIDES,
Wisconsin Univ., Madison. Dept. of Entomology.
E. P. Lichtenstein, K. R. Schulz, T. W. Fuhremann, and T. T. Liang.
Journal of Economic Entomology, Vol 62, No 4, p 761-765, 1969. 2 fig, 3 tab, 10 ref.

Descriptors: *Insecticides, *Pesticides, *Toxins, *Chlorinated hydrocarbon pesticides, Chemicals, Lethal limit, DDT, Toxicity, Aldrin, Dieldrin, Chromatography.
Identifiers: *Plasticizers, Polychlorinated biphenyls, Drosophila melanogaster, Musca domestica, Aroclor.

Polychlorinated biphenyls, classified as plasticizers, include oily liquids, white crystals, and hard resins. These structural cousins of DDT are components of numerous industrial products, including some insecticides. Eleven representatives of these chemicals were tested for their toxicity and toxicological interaction with dieldrin and DDT. Many of these compounds were toxic to Drosophila melanogaster and Musca domestica, the degree of toxicity increasing with a lower content of chlorine. Addition of plasticizers, even in sublethal doses, to dieldrin and DDT augmented the toxicity of the biocides. In recent years, plasticizers have found their way to tissues of many land and water inhabitants and present now a definite treat to biological systems, especially when combined with some other synthetic chemicals. (Wilde-Wisconsin)
W70-05552

WASTE-INDUCED OXYGEN UPTAKE OF AN ALASKAN ESTUARY,
Alaska Univ., College. Dept. of Environmental Health Engineering; and Alaska Univ., College. Inst. of Water Resources.
For primary bibliographic entry see Field 02L.
W70-05556

IMPOUNDMENT WATER QUALITY CHANGES CAUSED BY MIXING,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Basic and Applied Science Program.
For primary bibliographic entry see Field 05G.
W70-05558

MANAGEMENT AND MEASUREMENT OF DO IN IMPOUNDMENTS,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Applied Science Program.
For primary bibliographic entry see Field 05G.
W70-05559

IMPOUNDMENT DESTRATIFICATION BY MECHANICAL PUMPING,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Applied Sciences Program.
For primary bibliographic entry see Field 05G.
W70-05560

CONTINUOUS CULTURE IN MICROBIAL ECOLOGY,
Woods Hole Oceanographic Institution, Mass.
H. W. Jannasch.
Laboratory Practice, p 1162-1167, October 1965. 5 fig, 1 tab, 29 ref.

Descriptors: *Water pollution effects, *Microbiology, Analytical techniques, Ecosystems, Aquatic bacteria, Carbon dioxide, Hydrogen ion concentration, Marine bacteria, Methane, Kinetics, Red tide, Protozoa, Bacteriophage, Organic acids, Proteins, Yeasts, Sea water, E coli, Growth rates, Vitamins, Systems analysis.
Identifiers: *Continuous culture, *Microbial ecology, Holotrichs, Oligotrichs, Microbial populations, Chemostats, Open systems, Fatty acids, Enrichment cultures, Chlamydobacteriales, Thiovulum, Sphaerotilus, Percolation techniques, Blooms, Acetate, Glycerol, Substrate concentrations, Dilution rate, Pseudomonas, Sugars, Dictostelium, Peptone, Vibrio, Rumen ecology, Spirillum, Achromobacter, Selenomonas, Aerobacter.

Microbial populations in natural ecosystems are conceptualized as constituting many open systems, each controlled by a specific limiting factor and affected by frequently changing external conditions. Although steady states of even uni-specific populations are improbable under such conditions, growth of natural populations is better described by open system kinetics, as in continuous cultures, than in closed, batch cultures. Useful information regarding ecosystems has resulted from investigations of continuous culture properties, both heterogeneous and homogeneous, as defined in chemical engineering. Compared with homogeneous systems, survival and enrichment of certain naturally important species in heterogeneous continuous culture depends on various more poorly defined factors, most of them unrelated to elimination of unsuccessful competitors by dilution. Under conditions approximating nature, Sphaerotilus and Thiovulum have been enriched in such experimental cultures. Heterogeneous systems have also been employed to study soil microbiology (using percolation techniques) and biological treatment of industrial wastes. Employment of four dilution rates and four concentrations of substrate (glycerol) in chemostatic experiments permitted enrichment of six different species of marine bacteria from a single sample. Homogeneous systems have also been used to study growth in rumen organisms, and steady state interactions between various organisms, employing arrays of chemostats. (Eichhorn-Wisconsin)
W70-05561

FACTORS INVOLVED IN DISPOSAL OF SEWAGE EFFLUENTS TO LAKES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Sanitary Chemistry.
Clair N. Sawyer.
Sewage and Industrial Wastes, Vol 26, No 3, p 317-328, 1954. 6 fig, 3 tab, 10 ref, discussion.

Descriptors: *Lakes, *Sewage effluents, *Sewage disposal, Algae, Agricultural watersheds, Nutrients, Fertilization, Physical properties, Climate, Nitrogen, Phosphorus.
Identifiers: Algal blooms, Algae nutrition, Microcystis aeruginosa.

The significance of fertilization as the cause of algal blooming and the various physical, chemical, and biochemical factors that determine the safe loadings which may be applied are discussed. Fundamental considerations are sources of fertilizing matter reaching lakes including groundwater, surface runoff, and sewage effluents or industrial wastes; permissible nutrient or fertilizing levels; and factors considered of importance to lake behavior. Climate; physical factors of the lake including area, morphology, depth, temperature, and color; biological factors; and chemical factors including essential elements, carbon dioxide, pH, and feedback from bottom deposits are presented. The contour of the lake determines to a great extent when and how algal growth develops. For lakes that do not stratify, all nutrients are available; in stratified lakes, elements below the thermocline are sealed off from the active biological zone. Ecological relationships are an important factor in determining lake behavior. Nitrogen is needed in the greatest amount as a fertilizing element. Discussions of the paper by Professor Harold B Gotaas of University of California, Berkeley, and Professor James B Lackey of the University of Florida, Gainesville, are included. (Haskins-Wisconsin)
W70-05565

THE CHEMICAL CONTROL OF AQUATIC NUISANCES,
Wisconsin Committee on Water Pollution, Madison.
Kenneth M. Mackenthun.
Committee on Water Pollution, Madison, Wisconsin, January 1958, 64 p, 22 fig, 3 tab.

Descriptors: *Aquatic weed control, *Herbicides, *Copper sulfate, *Sodium arsenite, Nuisance algae, Snails, Legislation, Wisconsin, Chemcontrol, Pondweeds, Rooted aquatic plants, Rates of application, Application techniques, Swimming, Waterfowl, Birds, Costs, Cost-sharing.
Identifiers: Schistosome dermatitis, Copper carbonate, Cercariae, Water milfoil coontail, Wild celery, Bur reed, Duckweed, White water lily, Swimmers' itch.

A detailed description of methods of control of aquatic rooted vegetation, algae, and cercariae, causing swimmers' itch, is given. The biomass of aquatic weeds was reduced by sodium arsenite treatments in some 80 lakes with an approximate application efficiency of 150 gallons of herbicide per hour. One or more algae-eradicating treatments were given to about 40 lakes, an application of 250 pounds of commercial copper sulfate consuming one hour. Control of cercariae was successfully achieved in a limited number of lakes with a mixture of copper sulfate and copper carbonate. The efficiency of control measures was materially augmented by the use of specially designed equipment, including steel barges, portable aluminum alloy barges, spray boats and assemblies, loading booms, and gravity flow injectors. (Wilde-Wisconsin)
W70-05568

COMPREHENSIVE STUDY ON PROTECTION OF WATER RESOURCES OF LAKE TAHOE BASIN THROUGH CONTROLLED WASTE DISPOSAL,
Engineering-Science, Inc., Arcadia, Calif.; and Engineering-Science, Inc., Oakland, Calif.
For primary bibliographic entry see Field 02H.
W70-05615

FREE AMINO ACIDS AND RELATED SUBSTANCES IN MARINE ORGANISMS,
City of Hope Medical Center, Duarte, Calif.
Eugene Roberts, and J. S. Kittredge.
Available from the Clearinghouse as AD-697 976, $3.00 in paper copy, $0.65 in microfiche. Final Report, December, 1969, 24 p, 12 refs.

Descriptors: *Amino acids, Phosphorus compounds, *Aquatic microorganisms, Zooplankton.
Identifiers: *Phosphonic acids, *Anemones, Phosphonic acid/aminoethyl, Aminotransferases, Phosphonic acid/ (methylamino)ethyl, Coelenterata.

A survey of the free amino acids of over 400 tissues of marine organisms revealed a number of new compounds. An acidic amino acid was isolated from sea anemones and proved to be 2-aminoethylphosphonic acid (2-AEP). A new lipid, ceramide 2-amino-ethylphosphonic acid was isolated from sea anemones and characterized. Investigation of precursors of 2-AEP led to the isolation of a new alpha-amino acid, phosphonoalanine. The analogy of these with common nitrogenous bases led to the discovery of three more C-P compounds, N-methyl-2 AEP, N-dimethyl-2 AEP. Lipids containing the mono and trimethyl compounds were isolated. An investigation of the degradation of 2-AEP demonstrated the existence of a transaminase in Anthopleura and Tetrahymena using alpha-ketoglutarate as an acceptor. A study of the transport of aminoalkylphosphonic acids by bacteria revealed that they are taken up by the alpha-amino acid transport system. Biosynthesis of 2-AEP was shown to occur only during cell division and studies with 14C labeled precursors indicated that the most likely precursor is either phosphoenolpyruvic acid or oxaloacetate. Examination of zooplankton revealed that 3% of the total phosphorus was in C-P compounds. Cultures of coccolithophorids and dinoflagellates in labeled media demonstrated that these phytoplankton synthesize phosphonic acids. (Author)
W70-05631

CARBON SOURCES AND ALGAL COMMUNITY STRUCTURE AND METABOLISM IN A RESERVOIR UNDERGOING EUTROPHICATION BY DOMESTIC AND INDUSTRIAL EFFLUENTS,
Oklahoma State Univ., Stillwater. Reservoir Research Center.
Troy C. Dorris.
Available from the Clearinghouse as PB-191 062, $3.00 in paper copy, $0.65 in microfiche. Oklahoma State University, Oklahoma Water Resources Research Institute, Stillwater, Technical Completion Report, 1969. 112 p, 40 fig, 21 tab, 111 ref. OWRR Project No B-008-OKLA.

Descriptors: *Reservoirs, *Eutrophication, *Wastes, *Organic compounds, Analytical techniques, Chromatography, Spectrophotometry, Sewage effluents, Chlorophyll, Pigments, Productivity.
Identifiers: Keystone Reservoir (Okla), Arkansas River (Okla), Chloroform extracts, Butylmethylphenol, Steam volatile substances, Astacin-type carotenoids, Alcohol extracts.

Continuous sampling of trace aqueous organic compounds from the Keystone Reservoir and Arkansas River in Oklahoma was accomplished by the carbon adsorption method. Steam volatile compounds were determined by a combination of gas chromotograph-mass spectrometer assembly. Decreased concentration of carbon chloroform (CCE) and carbon alcohol (CAE) extracts in water of the reservoir is attributed to dilution, sedimentation, and bio-oxidation. Extracts from the Arkansas River arm contained some butyl-methylphenol (BHT), a probable constituent of sewage effluents. The annual content of chlorophyll a in the euphotic zone averaged from 33 to 59 milligram/cubic meter, indicating eutrophic nature of the reservoir.

According to estimates, 0.14 milligram ash-free (loss on ignition) surface samples contain 1.0 microgram of chlorophyll a. Contributions of phytoplankton to ash-free weight decreased with the depth of the basin. Most pronounced pigment diversity occurred in January and February. The range of gross productivity included annual means of 0.01 to 2.98 gram carbon per day and square meter. (Wilde-Wisconsin)
W70-05640

THE RATIONALE OF PALEOLIMNOLOGY,
Indiana Univ., Bloomington. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-05657

CULTURAL EUTROPHICATION WITH SPECIAL REFERENCE TO LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson.
Mitteilungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 19-32, 1969. 5 fig, 37 ref, discussion.

Descriptors: *Lakes, *Eutrophication, *Washington, Urbanization, Water pollution, Sediments, Paleolimnology, Nutrients, Productivity, Sedimentation rates, Stratigraphy, Bioindicators, Algae, Oligotrophy, Diversion, Cores, Sewage effluents, Diatoms, Phosphorus, Organic matter, Nitrogen, Chlorophyll.
Identifiers: *Lake Washington (Wash), *Cultural influences, Microcystis, Dredge samples, Anabaena, Seasonal effects, Decomposition rates, Chronology, Cladocerans, Chydorid cladocerans, Species composition, Microfossils, Competitive exclusion principle, Oscillatoria rubescens, Piston corer, Fragilaria, Melosira, Asterionella, Araphidineae, Centric diatoms, Bosmina, Diaphanosoma, Oscillaxanthin.

Eutrophication of Lake Washington by urban sewage and its subsequent recovery after installation of treatment facilities and effluent diversion are well documented. Paleolimnological evidence bearing on this case history is described. Of many diatoms occurring in cores, Fragilaria crotonensis dominates recently; Melosira italica, in the deeper (older) sediments; and Asterionella formosa occurs at all depths. No species, abundant at any depth, is missing from significant core sections. Relative composition of centric versus araphidinate groups of diatoms correlate with known lake's eutrophication history, large decreases in Araphidineae coinciding with diversion of raw sewage. Using species groups may overcome inherent disadvantages poised by considering single species as bioindicators. Animal fossils have been given little study, although Bosmina longirostris--common cladoceran in naturally or culturally eutrophic lakes--is known to be abundant throughout sediments, with increasing abundance seemingly paralleling period of enrichment. Based upon reasonably reliable marker layer, sedimentation since 1916 has proceeded at rate between 2.3 and 3.1 millimeters/year. Surficial sediments tend to be distinctly enriched in phosphorus, after interposed minimum in 1930-1940, when sewage was diverted. In general, extensive limnological data are scanty for lakes with history of eutrophication, making elucidation of paleolimnological correlatives difficult. (Eichhorn-Wisconsin)
W70-05663

EUTROPHICATION OF LAKES AND STREAMS, CAUSE AND PREVENTION (IN GERMAN),
Kantonales Laboratorium, Zurich (Switzerland).
E. A. Thomas.
Monatsbulletin des Schweizerischen Vereins Von Gas- und Wasserfachmannern, No 6/7, p 3-12, 1963. 7 fig, 24 ref.

Descriptors: *Eutrophication, *Lakes, *Rivers, *Algae, Water pollution control, Water pollution effects, Water pollution sources, Sewage, Phosphorus, Chemcontrol, Industrial wastes, Sewage treatment.
Identifiers: Ring tube, Canalization, Aluminum sulfate, Ferrichloride, Iron sulfate, Galvanizing wastes, Lake Zurich (Switzerland), Switzerland, Kilchberg (Switzerland), Zollikon (Switzerland), Lake Tegern (Bavaria), Lake Schlier (Bavaria), Lake Zell (Austria), Lake Hall wiler (Switzerland).

Water pollution was recognized in some countries a century ago when Zurich Kanton, Switzerland, enacted a law in 1881. While mechanical and biological treatment of sewage are the most generally used methods of water purification and eutrophication reversal, the resultant effluents still promote algae and higher water plants. Lakes surrounded by communities benefit by sewage canalization circling the lake, a process used for 50 years for a portion of Zurich and adjacent communities of Kilchberg and Zollikon, totaling a 50,000 population. Large lakes and those with irregular shorelines receiving sewage as well as nutrient-rich tributary streams require phosphate removal from sewage by aluminum sulfate, by ferrichloride, or by a combination of iron chloride and iron sulfate. Tests to precipitate phosphate in sewage proved promising, especially by a precipitant produced by Swiss soda plant, Zurzach, from pickle wastes, a product of galvanization (89.9% phosphate eliminated) at 1/3 to 1/4 cost of pure iron chloride. The product also served to eliminate industrial wastes and to produce a marketable commodity. Chemical control of nuisances, channeling the hypolimnion from a lake to remove nutrients, and oxygenation effects are discussed. (Auen-Wisconsin)
W70-05668

THE PRIMARY PRODUCTION IN LAKES: SOME RESULTS AND RESTRICTIONS OF THE C14 METHOD,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02K.
W70-05669

ECOLOGICAL EFFECTS OF SILVER IODIDE AND OTHER WEATHER MODIFICATION AGENTS: A REVIEW,
Michigan Univ., Ann Arbor, School of Natural Resources.
Charles F. Cooper, and William C. Jolly.
Water Resources Research, Vol 6, No 1, p 88-98, February 1970. 11 p, 4 tab, 49 ref. Contract 14-06-D-6576, Reclamation.

Descriptors: *Water pollution sources, *Water pollution effects, *Cloud seeding, *Silver iodide, *Reviews, Path of pollutants, Halides, Organic compounds, Surveys, Ions, Aquatic life, Fish, Aquatic environment.
Identifiers: Ecological effects.

The silver ion is among the most toxic of heavy metal ions, particularly to microorganisms and to fish. The ease with which Ag forms insoluble compounds, however, reduces its importance as an environmental contaminant. Ag is not likely to concentrate to harmful levels through either terrestrial or aquatic food chains. There is some possibility that Ag from cloud seeding will retard growth of algae, fungi, bacteria, and fish in fresh water; additional laboratory investigations are needed. Inhibition of aquatic microorganisms would interfere with the cycle that returns essential nutrients to the water. Ag in air and water should be regularly monitored. Iodine in AgI poses no environment danger. Organic seeding agents currently being proposed are not likely to be toxic in either the short or the long run, but dispersal of proprietary organic compounds should be prohibited unless their composition is fully revealed. (Knapp-USGS)
W70-05671

FRAGILE ESTUARINE SYSTEMS-ECOLOGICAL CONSIDERATIONS,
Texas Univ., Port Aransas. Inst. of Marine Science.
For primary bibliographic entry see Field 02L.
W70-05709

WATERBLOOM FORMING BLUE-GREEN ALGAE IN NORWAY AND THEIR IMPORTANCE IN THE STUDY OF THE INFLUENCE OF CULTURE ON THE WATER RESOURCES (IN NORWEGIAN),
Norsk Institutt for Vannforskning, Blindern.
Olav Skulberg.
English summary. Nordiske Jordbruksforskeres Forening, Vol 47, p 180-190, 1965. 2 fig, 3 tab, 20 ref.

Descriptors: *Cyanophyta, *Eutrophication, Seston, Lakes, Plankton, Water chemistry, Phytoplankton, Diatoms, Succession, Nutrients.
Identifiers: *Waterbloom, *Norway, Oscillatoria, Flagellates, Rodenessjoen (Norway), Aphanizomenon flos-aquae, Asterionella formosa, Melosira ambigua, Microcystis, Aphanothece clathrata, Merismopedia tenuissima, Anabaena.

Some common species of Cyanophyta causing water bloom in Norwegian inland waters and examples of their typical localities are discussed. Oscillatoria species have been reported previously in only a few cases as the cause of algal blooms in lakes in Norway. Plankton investigations during recent years have shown that Oscillatoria Agardhii var isothrix Skuja, Oscillatoria Agardhii Gom and Oscillatoria cf rubescens DC cause algal blooms in lakes receiving nutrients in excess of the natural supply. Some examples of blue-green algal blooms are briefly described. Considering eutrophication and lake succession, there is no slow and steady development from oligotrophic to eutrophic conditions; instead, periods of rapid change alternate with rather long periods of stability. The steplike evolution of lakes is demonstrated by corresponding changes in algae communities. The sudden occurrence of Oscillatoria cf rubescens DC in Lake Steinsfjord raises the question whether this is evidence of increasing eutrophication of the lake. Investigation of blue-green algae in Norwegian inland waters may bring important knowledge leading to the understanding of the process of eutrophication. (Jones-Wisconsin)
W70-05751

USE OF ALGAL CULTURE METHODS IN EUTROPHICATION RESEARCH (IN NORWEGIAN),
Norsk Institutt for Vannforskning, Blindern.
Olav Skulberg.
English summary. Nordiske Jordbruksforskeres Forening, Vol 47, p 211-215, 1965. 1 fig, 2 ref.

Descriptors: *Eutrophication, Algae, Cultures, Chlorophyta, Cyanophyta, Brackish water, Oligotrophy, Temperature, Light intensity, Chlorophyll, Nutrients, Conductivity, Agricultural watersheds, Sewage, Water pollution, Chemical analysis, Physical properties.
Identifiers: Bacillariophyceae, Selenastrum capricornutum Printz, Oscillatoria Vaucher, Skeletonema costatum (Grev) Cl, Chlorella ovalis Butcher, Njoer Lake (Norway), Hobol River (Norway), Van Lake (Norway).

Unialgal cultures are used in a procedure to measure the fertility of water receiving pollution with plant nutrients. The technique developed is considered a supplement to chemical and physical methods for the handling of eutrophication problems. Species from the classes of Chlorophyceae, Cyanophyceae, and Bacillariophyceae were used as test algae. Of these, Selenastrum capricornutum, which occurs widely in oligotrophic and eutrophic fresh water localities under natural conditions, was used for experimentation most extensively. Other suitable algae have been Oscillatoria Vaucher sp, Skeletonema costatum (Grev) Cl, and Chlorella ovalis Butcher. The method can be used to determine the efficiency of the water treatment plants in reducing plant nutrients in the effluent, and can measure the trophic level of water mass. Experimental methods are necessary to give a detailed understanding of

the biological phenomena which follow eutrophication. With careful and critical use of algal culture experiments, it would be possible to define numerical relations between the conditions of the water, degree of pollution and the biological situation. (Jones-Wisconsin)
W70-05752

PROGRESSIVE CHANGES IN THE CLADOCERAN AND MIDGE FAUNA DURING THE ONTOGENY OF ESTHWAITE WATER,
Indiana Univ., Bloomington.
Clyde E. Goulden.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 15, p 1000-1005, 1964. 2 fig, 13 ref.

Descriptors: *Midges, *Lakes, Eutrophication, Pollen, Sediments, Climates, Productivity, Sheep, Hypolimnion, Anaerobic conditions, Daphnia.
Identifiers: *Esthwaite Water (England), *Cladocera, *Ontogeny, Chydoridae, Daphniidae, Bosminidae, Sididae, Polyphemidae, Leptodoridae, Deforestation, Chironomus, Sergentia, Tanytarsus, Ceriodaphnia.

Changes in total populations throughout Esthwaite Water's history and successional changes of Cladocera and midges associated with eutrophication are discussed. The Cladocera species were divided into the 'chydorids' and the 'non-chydorids,' mostly planktonic in habit. The Cladocera and midges suggest that Esthwaite Water was an oligotrophic lake during most of its development and only within the last 900 years became eutrophic under man's influence. Further, they indicate there were four periods of increased productivity during the lake's development associated with climatic or cultural changes in the drainage basin. Greater productivity is expected in these intervals, and the fact that the Cladocera correctly suggest this implies that they can be of great usefulness for determining past productivity in lakes. Cladoceran remains in lake sediments appear to be a valuable tool for paleolimnologists. They may be used to determine periods of climatic and cultural changes and for deducing past limnological conditions of a particular body of water. By studying the distribution and abundance of individual species in the sediment, we can estimate the ecological requirements of these species. This in turn will suggest fruitful areas of further research on living forms. (Jones-Wisconsin)
W70-05755

FAYETTEVILLE GREEN LAKE, NEW YORK. V. STUDIES OF PRIMARY PRODUCTION AND ZOOPLANKTON IN A MEROMICTIC MARL LAKE,
Cornell Univ., Ithaca, N.Y. Div. of Biological Sciences.
For primary bibliographic entry see Field 02H.
W70-05760

THE EUTROPHICATION OF LAKES AND THE RADICAL CHANGE OF THEIR MATERIAL CONTENT (IN GERMAN),
Waldemar Ohle.
Limnologiska foreingen i Finland, Limnologisymposion, Helsinki, 10-23, p 1-16, 1964. 10 ref.

Descriptors: *Eutrophication, *Lakes, Nutrients, Fertilization, Bacteria, Algae, Plankton, Tubificids, Calcium, Silicates, Diatoms, Winds, Nitrogen, Phosphates, Methane, Mud, Oxygen, Anaerobic conditions, Hydrogen sulfide, Iron, Fungi, Clays, Brackish water, Fisheries, Limnology.
Identifiers: Chironomids, Lake Constance, Whitefish, Wurttemberg (Germany), Plon (Germany), Lake Schlier (Germany), Lake Tegern (Germany), Germany, Finland, Sewage ring tubes.

Most North German lakes have been subject to eutrophication since early 1930's due to domestic sewage inflows and alluvial soil particles. At the end of summer stagnation, hypolimnetic oxygen is replaced by hydrogen sulfide in solution. The sediments, accumulating lake nutrients, are regarded as resultant of autochthon dynamics of metabolism and influences of regional surroundings. 3% to 5% of the mineral fertilizer washed from sloping fields are extremely high amounts for lakes with no dense plant growth, especially because of phosphate enrichment. Higher amounts of phosphorus are added by sewage, supplemented by detergents. Phosphate is a dominant production factor with nitrogen compounds of secondary importance. When large amounts of organic substances have accumulated so that dissolved oxygen in deep water is consumed by bacterial activity, larger amounts of nutrients are released from mud into hypolimnion. The more bacterial methane oxidation develops, the higher utilization of oxygen, thus more nutrients are recirculated from the mud into the water under anaerobic conditions. The increasing primary production is intensified exponentially. All sewage should be diverted from lakes by various means and chemical treatment coordinated with biological purification. (Jones-Wisconsin)
W70-05761

THE EFFECT OF CYCLING TEMPERATURES ON ELECTROLYTE BALANCE IN SKELETAL MUSCLE AND PLASMA OF RAINBOW TROUT; SALMO GAIRDNERI,
Alberta Univ., Edmonton, Alberta. Dept. of Zoology.
Daniel P. Toews, and C. P. Hickman, Jr.
Comp. Biochem Physiol., Vol. 29, p. 905 - 918, 1969. 2 tab, 11 figs., 17 refs.

Descriptors: *Rainbow trout, *Water temperature, Ions, Potassium, Sodium, Chlorides, *Fish physiology, *Electrolytes, *Acclimatization, Thermal stress.
Identifiers: Salmo gairdneri, *Plasma ions, *Muscle chloride, *Cyclic temperatures, Extra-cellular fluid volume, Muscle sodium.

Rainbow trout, Salmo gairdneri (1 1/2 yr old) were acclimated to a daily temperature cycle ranging from 8 to 18 deg C. Control fish were maintained at constant temperatures which coincided with the sample temperatures of the cycling fish. Sodium, potassium, chloride and water were measured in the plasma and muscle of all the fish. In most cases the plasma ion levels in the cycling fish did not exceed those levels of the control fish which were held at low temperatures (8-10 deg C). There was a highly significant inverse relationship between the muscle potassium and the muscle sodium levels in the cycling fish. Control fish did not exhibit this inverse relationship. Evidence from plasma and tissue concentrations of electrolytes in both the cycling and control trout indicated that cycling trout acclimated to the lowest temperatures of the cycles. (Sjolseth and Katz-Washington)
W70-05763

TOXIC EFFECT OF ELEMENTAL PHOSPHORUS ON L-CELLS CULTIVATED IN SUSPENSION,
Fisheries Research Board of Canada, Halifax (Nova Scotia). Halifax Lab.
M. F. Li, G. S. Traxler, and L. M. Langille.
Canadian Journal of Zoology, Vol. 48, (1) p 133-136, 1970. 5 figs, 1 table, 10 refs.

Descriptors: *Phosphorus, Inhibition, *Toxicity, Water pollution effects, Cultures, Fish kill, Viability, *Cytological studies.
Identifiers: *Spinner culture, *L-cells, *Cellular morphology, *Cell replication, Cytoplasm, Nuclei.

Recent mass mortalities of herring, Clupea harengus, occurring in Placentia Bay, Newfoundland, have been attributed to seawater pollution by elemental phosphorus. The effects of elemental phosphorus upon cell replication and cellular morphology were tested on L-cells grown in spinner culture. The cell replication was completely inhibited by the presence of elemental phosphorus in the culture medium at 1.25 mg/l. At 0.31 mg/l, 74% inhibition of the cell replication was observed. A calculated correlation coefficient between the percentage inhibition and the phosphorus concentration was valid at the 1% level. The phosphorus significantly altered the cellular morphology. The affected cells showed ballonization, loss of stain-binding capacity, disintegration of cytoplasm, enlarged nuclei with vacuolated nucleoli, and formation of multiple nucleated giant cells. A possible sequence of the changes was discussed. (Sjolseth-Washington)
W70-05764

CLUSTER ANALYSIS OF POTOMAC RIVER SURVEY STATIONS BASED ON PROTOZOAN PRESENCE-ABSENCE DATA,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
John Cairns, Jr., and Roger L. Kaesler.
Hydrobiologia, Vol. 34, p 414-432, 1969. 1 tab, 8 figs, 28 refs.

Descriptors: Water analysis, *Analytical techniques, Bioindicators, Environmental effects, On-site data collections, Surveys, Aquatic environment, Water pollution effects, *Limnology, Chemical properties, Biological properties, *Electric power plants, *Protozoa, Computer programs, *Aquatic populations, *Thermal pollution, Urbanization.
Identifiers: *Potomac River, *Cluster analysis, Jaccard coefficients.

Four high-water and six low-water limnological surveys of a portion of the Potomac River were made form 1956 to 1965; samples were collected at three stations on each survey to determine the effects of operation of the PEPCO Dickerson Power Station on the aquatic biota. Cluster analyses were made of various combinations of Jaccard coefficients relating 46 aggregations of 647 protozoan species. Similarities of aggregations of species within a survey were nearly always greater than similarities among aggregations from different surveys, indicating linear or along-stream environmental influences. Within-survey similarities for the early and late surveys were usually higher than similarities within middle-year surveys, a possible indication of environmental change at all stations, including the control, and subsequent biotic readjustment. Clustering of the 1956 aggregations, taken under high-water conditions before plant operations began, with aggregations from other surveys for any one station indicate that 1956 may have been different from other survey years. One explanation is that increased urbanization upstream from the power station after 1956 caused some environmental change. No changes in aquatic biota could be attributed to thermal pollution. (Sjolseth and Katz-Washington)
W70-05765

THE EFFECT OF TEMPERATURE ON THE RESPIRATORY AND CARDIAC RESPONSE OF THE BLUEGILL SUNFISH TO HYPOXIA,
Virginia Polytechnic Inst., Blacksburg.
Kenneth W. Spitzer, Daniel E. Marvin, Jr., and Alan G. Heath.
Comp. Biochem. Physiol., Vol. 30, p. 83 - 90, 1969. 4 figs, 1 tab, 17 refs.

Descriptors: *Water temperature, *Acclimatization, *Fish physiology, Fish behavior, Ventilation, Oxygenation, Respiration, Environmental effects.
Identifiers: *Bluegill sunfish, Lepomis macrochirus, *Heart rate, *Hypoxia, *Oxygen consumption, Bradycardia.

Bluegill sunfish were acclimated to 30 plus or minus 1, 25 plus or minus 1, and 13 plus or minus 1 deg C, and then subjected to gradually induced environmental hypoxia. Routine oxygen consumption, ventilation rate and heart rate were measured at varying oxygen concentrations. Fish at 25 and 13 deg C showed varying degrees of oxygen independence. Those at 30 deg C exhibit oxygen dependence. During hypoxia, ventilation rate increases in

both 13 and 25 deg C fish but failed to do so at 30 deg C. Bradycaadia occurred in all acclimation temperatures. The results indicate that the environmental temperature of the bluegill significantly affects its response to gradual hypoxia. (Sjolseth and Katz-Washington)
W70-05766

CLUSTER ANALYSIS OF OCCURRENCE AND DISTRIBUTION OF INSECT SPECIES IN A PORTION OF THE POTOMAC RIVER,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
Selwyn S. Roback, John Cairns, Jr., and Roger L. Kaesler.
Hydrobiologia, Vol. 34, p. 484-502, 1969, 8 figs, 2 tab, 22 refs.

Descriptors: *Thermal pollution, *Limnology, Surveys, On-site data collections, Aquatic environment, Water pollution effects, *Electric power plants, Computer programs, *Aquatic population, Bioindicators, *Analytical techniques, Environmental effects, Protozoa, Urbanization, *Aquatic insects.
Identifiers: *Potomac River, *Cluster analysis, Jaccard Coefficients.

Limnological surveys of a portion of the Potomac River were made from 1956 to 1965 to determine the effects of operation of the PEPCO Dickerson Power Station on the aquatic biota. Samples were collected at three stations on each of four high-water and six low-water surveys. Cluster analyses were made of various combination of Jaccard coefficients relating 50 aggregations of 370 insect species. Similarities of aggregations of species within a survey were in all cases greater than similarities among aggregations from different surveys, indicating relatively strong within-year or along-stream environmental influences. Clusters of aggregations from middle-year surveys show a greater similarity to each other than to the earlier or later surveys, possibly indicating environmental change at all stations, including the control. The marked dissimilarity of aggregations from the last survey to all others suggests biotic change in the river. One explanation is that increased urbanization upstream from the power station after 1956 caused some environmental change. No changes in aquatic biota can be attributed to thermal loading as a direct result of operation of the electric power generating station. (Sjolseth and Katz-Washington)
W70-05767

THERMAL POLLUTION: STATUS OF THE ART,
Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 05D.
W70-05778

ENVIRONMENTAL TEMPERATURE AND PLASMA ELECTROLYTE REGULATION IN THE CARP, CYPRINUS CARPIO,
Marquette Univ., Milwaukee, Wis. Dept. of Biology.
A. H. Houston, and Jane A. Madden.
Nature, Vol. 217, p969-970, March 9, 1968. 1 tab, 8 ref.

Descriptors: *Temperature, *Environmental effects, *Carp, Osmosis, Thermal pollution, Heat, Toxicity, Fish, Electrolytes, Ions.
Identifiers: Cations, Anions.

During a study of systemic aspects of the thermoacclimatory process, the relation between temperature and electrolyte-regulatory ability in a typical freshwater eurytherm, the common carp, was studied. The fish were acclimatized to 4 deg, 17 deg, 27 deg, and 33 deg for intervals of not less than 3 weeks. Both regulations and its precision were modified by temperature. Plasma sodium concentrations were a maximum at 27 deg, with a mean concentration of about 9-10 millimoles/l greater than those at 4 deg or 33 deg. By contrast, chloride concentrations increased from a mean of 115.6 millimoles/l at 4 deg C to 137.0 at 33 deg. Coupled with this the precision of chloride regulation diminshed markedly at higher temperatures. Phosphate concentration increased sharply between 4 deg and 17 deg and then diminshed slowly. Plasma calcium also increased with temperature from 1.94 millimoles/l at 4 deg to 2.54 at 33 deg. Potassium and magnesium concentrations displayed no consistent variations. The ratio of plasma chloride to total cations increased with temperature, suggesting that the concentration of some anionic species, presumably HCO3-, increases at lower temperatures. A fall in plasma osmolarity at increased temperatures, with a pronounced drop between 27 deg and 33 deg, is suggested. In contrast, the sum of all cations plus chloride steadily rose with temperature. (Novotny-Vanderbilt)
W70-05780

NEW CONCEPT FOR MANAGING AQUATIC LIFE SYSTEMS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 06G.
W70-05795

EFFECTS OF RESERVOIR IMPOUNDMENT ON WATER QUALITY,
Corps of Engineers, Savannah, Ga. Special Programs Section.
Frank H. Posey, Jr., and Jospeh W. DeWitt.
ASCE Proceedings, Journal Power Division, Vol 96, No PO1, Paper 7041, p 173-185, January 1970. 13 p, 5 fig, 10 ref, append.

Descriptors: *Water quality, *Dissolved oxygen, *Reservoirs, *Thermal stratification, Reservoir operation, Water pollution sources, Water pollution control, Reaeration, Heat balance, Water temperature, Environmental engineering, Water resources development, Mixing.
Identifiers: Reservoir reaeration.

The problem of correcting the adverse effects of thermal stratification and low dissolved oxygen content in large reservoirs and controlling physical, chemical, and biological parameters of released water from impoundments in the Southeastern United States is described. The results of water quality investigations at the Clark Hill and Hartwell Reservoirs are outlined along with predictions of quality expected at West Point Reservoir. Comparisons are made of various possible corrective solutions investigated such as: (1) Multilevel penstock intakes; (2) submerged weirs; (3) tailrace and turbine aeration; and (4) destratification systems. Emphasis is placed on a diffused air pumping system prototype equipment test at Allatoona Reservoir in North Georgia. A description is given of the destratification equipment being tested, and details of the types and methods of sampling and data processing are described. (Knapp-USGS)
W70-05883

5D. Waste Treatment Processes

WASTE WATER RECIRCULATION AS A MEANS OF RIVER POLLUTION ABATEMENT,
British Columbia Sugar Refining Company Ltd., Vancouver; and Manitoba Sugar Company Ltd., Winnipeg.
W. W. Blankenbach, and W. A. Willison.
Journal of the American Society of Sugar Beet Technologists, Vol 15, No 5, p 396-402, 1969. 3 fig.

Descriptors: *Waste water treatment, *Water pollution sources, *Industrial wastes, Sugar beets, Industrial water, Water reuse, Sludge, Settling basins, Rivers, Costs, Recirculated water, Compensation.
Identifiers: Clarifier, Fort Garry (Manitoba), Red River (Canada), Recirculation system.

A successful project by Manitoba Sugar Company, Fort Garry, Manitoba, to reduce river pollution by eliminating sugar beet processing wastes is described. The company's sewage charges exceeded $64,000 per year exerting economic pressure to reduce its pollution load. A recirculation system was put into operation in 1965. Traveling and vibrating screens remove larger organic material. A clarifier removes particulate matter and suspended solids. Lime is added at the clarifier to raise the pH to 11.5+ to improve coagulation and sedimentation. The clarifier overflow is recirculated to the flume water supply tank and the underflow is pumped to mud settling ponds. Clean water is collected in a collector ditch and returned to the clarifier. The installed cost of the system, excluding screens, amounted to approximately $300,000. Operating expense is limited to lime addition (1.5-4.5 tons per day). Concentration of dissolved solids in the recirculating water builds steadily, but levels out at about 10,000 ppm of total dissolved solids and 6000 ppm biochemical oxygen demand. The increased concentration of dissolved solids in the recirculating system is felt to produce significant savings of sugar by reducing osmotic pressure differentials. The soil in the sludge beds apparently is stabilized and no problem is expected in disposing of the dry sludge. (Haskins-Wisconsin)
W70-05551

TEMPORARY WATER CLARIFICATION SYSTEM,
Georgia-Pacific Corp., Portland, Oreg.
M. Gould, and J. Taylor.
Chemical Engineering Progress, Vol 65, No 2, p 47-49, 1969. 7 fig.

Descriptors: *Waste water treatment, *Phenols, *Industrial water, Sewage lagoons, Sewage treatment, Resins.
Identifiers: Suspended solids, Activated carbon bed, Caustic solution regenerant.

Two lagoons used to impound and store phenol wastewater by a Georgia-Pacific resin plant at Conway, North Carolina, reached the capacity where continued use could cause overflow and subsequent serious pollution to a nearby stream. Waste water analysis showed 1400 ppm suspended solids and 2500 ppm phenol. Laboratory investigation indicated a two-stage clarification process followed by absorption with granular carbon. Addition of 1.0-1.5 milliliter sulfuric acid per gallon followed by 24 hour retention reduced suspended solids to less than 50 ppm. Adsorption tests showed 300 granular activated carbon removed phenol and color completely. Field trials showed carbon's working capacity 20% by weight and confirmed that absorbed phenol and total organic carbon could be removed from the activated carbon with 2.5 bed volume of hot caustic regenerant. On the basis of the laboratory and field trials, a temporary treatment system was installed and put into operation in September 1968. The makeshift system proved a superior way to handle plant wastes. Successful pilot operation has resulted in a proposal to install a permanent 25 to 50 gallon/minute system designed for continuous treatment. (Haskins-Wisconsin)
W70-05553

TERTIARY TREATMENT OF MUNICIPAL SEWAGE EFFLUENTS,
Rohm and Haas Co., Philadelphia, Pa.
Frank X. Pollio, and Robert Kunin.
Environmental Science and Technology, Vol 2, No 1, p 54-60, 1968. 2 fig, 8 tab, 8 ref.

Descriptors: *Sewage treatment, *Brackish water, *Desalination processes, Sewage effluent, Tertiary treatment.
Identifiers: Amberlite IRC-84, Dealkalization, Desal process, Bentonite, Primafloc C-7, Haddonfield (NJ).

The Desal process for the desalination of brackish waters using ion exchange units has been modified

so that secondary sewage effluents are renovated, producing clarified, odor-free water. The modified process effects simultaneous reduction in both the organic and inorganic mineral content of sewage water, offers operational flexibility, and can be engineered to produce water for industrial, agricultural, or domestic use. (Auen-Wisconsin)
W70-05554

FOAM FRACTIONATION,
Advanced Waste Treatment Research Program, Cincinnati, Ohio.
C. A. Brunner, and D. G. Stephan.
Industrial and Engineering Chemistry, p 40-48, May 1965. 9 fig, 4 tab, 4 ref.

Descriptors: *Foam fractionation, *Surfactants, Alkylbenzene sulfonates, Municipal wastes, Detergents, Linear alkylate sulfonate, Chemical oxygen demand, Laboratory tests, Pilot plants, Capital costs, Operating costs, Biodegradation.
Identifiers: Cationic polyelectrolyte additives, Gas-liquid feed ratios.

The scope of a research effort to apply foam fractionation theory to remove surfactants from municipal waste streams and a practical design approach to eliminate chemical oxygen demand (COD) and alkyl benzene sulfonate (ABS) are presented. Continuous runs on municipal effluents from seven treatment plants were carried out in laboratory-scale glass foam fractionation columns. The COD and methylene blue detectable ABS concentrations were determined in the feed, in the bottom product, and for some samples in the collapsed foam. The fraction removed for primary effluents for COD and ABS were 24% and 50%. For secondary effluents, COD and ABS removals were 25% and 70%. Data were collected from a pilot-scale foam separator in Pomona, California, over a 5-month period. At a gas to liquid feed rate greater than 5, about 35% of the gross organic contaminants were removed. Suspended solids and ABS each contributed about 40% of the total COD removed and therefore roughly 20% of the total organic material separated was soluble non-ABS organics. An average ABS removal of about 70% can be expected. The addition of selected cationic polyelectrolytes to the feed can improve removals. A summary of typical capital and operating costs for foam separators is given. (Haskins-Wisconsin)
W70-05562

A STUDY OF THE EFFECTS OF DIVERTING THE EFFLUENT FROM SEWAGE TREATMENT UPON THE RECEIVING STREAM,
Wisconsin Committee on Water Pollution, Madison.
Kenneth M. Mackenthun, Lloyd A. Lueschow, and Clarence D. McNabb.
Transactions of Wisconsin Academy of Sciences, Arts and Letters, Vol 49, p 51-72, 1960. 9 fig, 1 tab, 8 ref.

Descriptors: *Sewage effluent, *Diversion, *Stream, Sludge, Nitrogen, Phosphorus, Biochemical oxygen demand, Dissolved oxygen, Phytoplankton, Midges, Larvae, Worms.
Identifiers: *Madison (Wis), *Badfish Creek (Wis), Yahara River (Wis), Madison lakes (Wis).

About 20 million gallons of effluent per day from the Madison, Wisconsin, sewage plant were diverted into a small stream, Badfish Creek, reconstructed to accommodate a flow of approximately 50 cubic feet/second. In spite of considerable current velocity, sporadic sludge deposits were formed on the creek bottom. The effluent substantially increased the water content in organic and ammonia nitrogen, phosphorus, and biochemical oxygen demand; the dissolved oxygen was reduced to a critical level many times during the summer. There was an indication that the diversion of sewage decreased the volume of phytoplankton and changed the composition of plant community. Much of the creek bottom became covered with Oscillatoria. Bottom organisms have undergone severe degradation in their balanced population, replaced in a large part by sludge-tolerant worms and midge larvae. (Wilde-Wisconsin)
W70-05564

SMALL-SCALE CLARIFICATION UNIT FOR RADIOACTIVE SEWAGE,
Oak Ridge National Lab., Tenn.
R. Schulze-Rettmer, and K. H. Rattay.
Available from the Clearinghouse as ORNL-tr-1080, $3.00 in paper copy, $0.65 in microfiche. Trans. from Atompraxis, Vol. 11, p. 320-322, 1965. ORNL trans by Kenneth S. Warren, 17 Feb 66, 4 p.

Descriptors: *Sewage, *Radioactive waste, Labeled substances, Urine, West Germany, *Wastewater-treatment.
Identifiers: *Radioactive waste processing.

For digesting the radioactive sewage effluent from a radiological hospital, a small sewage-treatment device was installed in which the biological material of the waste water was chemically oxidized. This was desirable in order to assist the decontamination process. After homogenizing the solids, the sewage was warmed to 80 degree C and potassium peroxodisulfate was added. The addition of acid was advantageous. The efficiency was similar to that of good biological sewage treatment plants. The amount of sludge occurring in the waste water was small. Both sludge and water may afterwards be decontaminated in a further treatment system. The oxidized components were sterilized, and after neutralization were no longer toxic.
W70-05629

WASTE WATER RECLAMATION PROJECT FOR ANTELOPE VALLEY AREA,
Los Angeles Dept. of County Engineer, Calif.
John A. Lambie.
Available from the Clearinghouse as PB-191 067, $3.00 in paper copy, $0.65 in microfiche. Los Angeles County Department of Engineer Report, August 1968. 225 p, 14 fig, 32 tab, 71 ref. FWPCA Project 17080---8/68.

Descriptors: *Water reuse, *Reclaimed water, *California, Water quality, Aesthetics, Recreation, Fishing, Algae, Nutrients, Turbidity, Tertiary treatment, Sampling, Monitoring, Water demand, Water supply, Arid lands, Limnology.
Identifiers: Los Angeles County (Calif).

An economically feasible waste water renovation process was developed in Los Angeles County. The tertiary treated product water is pathogenically safe, esthetically pleasing and suitable for fish life. Primary use of the water will be for an aquatic recreation park, but other anticipated uses include soil reclamation, irrigation, and industrial applications. These reuses of waste water will result in the conservation of the presently diminishing fresh water supply in this arid area. All research and testing was done with the knowledge that ultimately the public must accept the concept of reuse of renovated waste water for the project to be a total success. Esthetics of the product water, including clarity, color and odor were important aspects of the treatment process. Test data demonstrate that bacteriological and viral requirements can be met. Fish have successfully survived and propagated in the test ponds. Algal growth and nutrient levels of water in the pilot ponds are considered within acceptable limits.
W70-05645

DEVELOPMENT OF A SYMBIOTIC ALGAL-BACTERIAL SYSTEM FOR NUTRIENT REMOVAL FROM WASTEWATER,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
F. J. Humenik, and G. P. Hanna, Jr.
24th Annual Purdue Industrial Waste Conference, May 6-8, Purdue University, Lafayette, Indiana, 1969. 16 p, 7 fig, 1 tab, 15 ref.

Descriptors: *Waste water treatment, *Nutrients, Algae, Bacteria, Cultures, Chemical oxygen demand, Nitrogen, Phosphates, Biomass, Symbiosis, Oxydation lagoons.
Identifiers: *Chlorella pyrenoidosa, Synthetic sewage feed, Symbiotic relationships.

An algal-bacterial culture, developed by inoculation of wastewater with Chlorella pyrenoidosa, proved to be efficient in removing certain nutrients from the effluents. Under optimum conditions, the algal-bacterial floc settled very rapidly, yielding a clear supernaut. The average removal of phosphates, however, was less than 3%. Maximum removal of chemical oxygen demand and organic nitrogen was obtained during unaerated operation with harvesting. The biomass oxidation required 1.27 milligrams of oxygen/milligram of solids. Supplemental aeration failed to improve either removal or conservation of nutrients. The term 'symbiotic culture' was introduced on the basis of a steady-state equilibrium in the oxygen concentration, maintained by photosynthetic oxygenation and total respiration. (Wilde-Wisconsin)
W70-05655

CASUAL OBSERVATIONS OF PROTOZOA IN TERTIARY SEWAGE TREATMENT,
Illinois State Water Survey, Peoria. Water Quality Section.
Ralph L. Evans, and Davis B. Beuscher.
Presented at 62nd Annual Meeting of the Illinois State Academy of Science, Millikin University, Decatur, April 25, 1969. 17 p, 6 fig, 2 tab, 18 ref.

Descriptors: *Tertiary treatment, *Sewage, *Biochemical oxygen demand, *Sewage lagoons, Protozoa, Flocculation, Suspended load, Turbulence, Dissolved oxygen.
Identifiers: Rhizopoda, Flagellata, Ciliophora, Ciliates, Illinois River, Residence time.

Tertiary sewage treatments include microstraining, land irrigation, sand filters, and tertiary sewage ponds (TSP). The latter appear to be most suitable for Illinois conditions, particularly as a method promising a reduction of 5-day biochemical oxygen demand (BOD). A 24-acre TSP was interposed between the Peoria activated sludge plant and the receiving stream, the Illinois River. This study was primarily concerned with the pond population of protozoa: Rhizopoda, Flagellata, and Ciliophora. The flagellates were the predominant organisms, exceeding 2 million/liter. The relationship between the 5-day BOD and volatile suspended solids (milligram/liter) of the pond influent (x-sub-1) and the effluent (x-sub-2) was expressed by regression equations x-sub-1 = 18.1 - 0.58 and x-sub-2 = 7.3 - 0.97, respectively. The limited effect of tertiary treatment of sewage on BOD is attributed to deficiency of oxygen and immobilization of activity of ciliated protozoa. A need for a slight increase in dissolved oxygen content of the medium is suggested. A taxonomic picture of sewage-inhabiting protozoa is presented. (Wilde-Wisconsin)
W70-05664

WASTE TREATMENT FOR THE CONTROL OF HETEROTROPHIC AND AUTOTROPHIC ACTIVITY IN RECEIVING WATERS,
Harvard Univ., Cambridge, Mass. Dept. of Water Resources.
Werner Stumm, and Mark W. Tenney.
Proceedings 12th Southern Municipal Industrial Waste Conference, Raleigh, North Carolina, p 97-111, 1963. 5 fig, 1 tab, 15 ref.

Descriptors: *Waste treatment, *Waters, *Organisms, Streams, Water pollution, Animals, Bacteria, Fungi, Algae, Floating plants, Rooted aquatic plants, Self-purification, Biochemical oxygen demand, Toxicity, Oxygen-reduction potential, Solar radiation, Energy, Carbon dioxide, Photosynthesis, Growth rate, Aerobic conditions, Anaerobic conditions, Biological treatment, Fertilization, Rivers, Sewage, Phosphorus, Nitrogen, Carbon, Aluminum.
Identifiers: Mathematical studies, Autotrophic, Heterotrophic.

The feasibility of aerobic biological waste treatment with complementary chemical treatment for flocculation of dispersed microorganisms and removal of phosphates has been experimentally corroborated. Results were obtained on the efficiency of organic carbon removed by biological and subsequent chemical treatment with alum. Chemical treatment alone (without prior biological substrate utilization) does not remove organic carbon to an appreciable extent. Bacteria, in the flocculation process, act as hydrophilic colloids. The stoichiometric relation between coagulant dose and number of microorganisms (or organic carbon of biological solids) is indicated. The required total coagulant demand is a function of both the concentration of dispersed microorganisms and the concentration of phosphorus present. Results illustrate that chemical coagulative methods can serve as a valuable complement to the biological substrate utilization processes. The complementary chemical and biological treatment is more economical than the conventional biological treatment; it is certainly more economical than a conventional bi9logical treatment followed by a third stage chemical treatment. In those cases where chemical treatment is more beneficial than biological treatment, the proposed treatment combination appears to be, even from an economical point of view, the most expedient waste purification arrangement. (Jones-Wisconsin)
W70-05750

COMPUTER AIDED DESIGN OF WASTE WATER TREATMENT PLANTS,
Michigan Univ., Ann Arbor. Dept. of Environmental Health.
Rolf A. Deininger, Robert W. Parrot, and Handi Akfirat.
Water Research, Vol 3, p 834-839, 1969. 3 fig, 2 ref.

Descriptors: *Digital computers, *Design, *Planning, *Waste water treatment, Design standards.
Identifiers: Remote terminals, Teletype.

The study proposed new applications of digital computers in the planning and design of waste water treatment plants. It reported that since these systems are numerical in nature and expressed in equations and inequalities, the rules and standards that regulate design can be stored in a digital computer where the designer interacts with the system via remote terminals. Instructions are stored in a large computer shared by many users at different geographical locations. A state agency specifies its particular design standards, they are entered in the computer, and the consulting engineer designing the plant uses the system from his offices via telephone lines. To explore these possibilities several computer programs were written which allowed the engineer to design different units of a treatment plant from a teletype terminal located in the School of Public Health at the University of Michigan. This unit was the source of all statements and all responses were printed out there. In this way, it was stated that engineers need not be familiar with any particular computer language, but have only the capability of operating a teletype terminal. (Kriss-Cornell)
W70-05777

THERMAL POLLUTION: STATUS OF THE ART,
Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
Frank L. Parker, and Peter A. Krenkel.
Available from School of Engineering, Vanderbilt University, Nashville, Tenn, 37203--Price $4.00. National Center for Research and Training in Hydrologic and Hydraulic Aspects of Water Pollution Control, Vanderbilt University, Report No. 3, December 1959. 550 p, 37 fig, 21 tab, 582 ref. FWPCA Project 16130 ENT---12/69, Grant WP-01387-01.

Descriptors: *Thermal pollution, *Thermal power plants, *Temperature, *Cooling water, Thermodynamics, Aquatic life, *Aquatic environment, *Mathematical models, *Benefits, *Cooling towers, Model studies, Cooling.
Identifiers: Cooling ponds, Heat dissipation, Run of river cooling, Comparison of cooling methods.

This document is an assemblage of the most current published information dealing with the causes, the effects, and the control and abatement of thermal pollution. Discussion of the current and projected growth of the thermal-electric power industry demonstrates the magnitude of the problem. A brief thermodynamic description of the power cycle, and alternatives to the central generating station are included. The effects of temperatures on various aquatic flora and fauna, with emphasis on field observations; the beneficial effects of heat additions; and the effects of heated discharges on water quality and assimilation are discussed in detail. Other subjects of review include the mechanisms of heated water discharges, the prediction of heat dissipation, the modeling of heated water discharges, cooling ponds, and run of river cooling. Various conventional and new designs for cooling towers, the problems associated with cooling towers, and a comparison of various cooling methods are also included. Extensive bibliographies, as well as the needs for future research related to each specific topic are included. (See also W70-05059). (Speakman-Vanderbilt)
W70-05778

INTERNAL HYDRAULICS OF THERMAL DISCHARGE DIFFUSERS,
Tennessee Valley Authority, Norris. Engineering Lab.
Svein Vigander, Rex A. Elder, and Norman H. Brooks.
Journal of the Hydraulics Division, ASCE, Vol. 96, HY2, Proc. Paper 7085, p509-527, February, 1970. 17 fig, 3 tab, 6 ref.

Descriptors: *Diffusion, *Electric powerplants, *Hydraulics, *Pipe flow, *Discharge coefficients, Thermal pollution, Reynolds number, Model studies.
Identifiers: *Pipe flow, Spacing ratios, Friction factor, Diffusers.

The TVA Browns Ferry Nuclear Plant will discharge its heated condenser cooling waters into the Wheeler Reservoir. To protect the plant, and to keep within state and Federal temperature limits, the warm effluent will be mixed with the reservoir water through a subsurface diffuser system. The diffusers consist of three approximately 20 ft. diameter corrugated steel pipes each with 7800 2-inch holes in the wall through which all the warm water discharges will be forced. The discharge coefficient can be written as C = F (d/D, R, (U sq.)/2gE, Sn/d, Sp/d, f, k/d) where Sn and Sp are the hole spacings normal to and parallel to the corrugations, d is the hole diameter, R is the Reynolds number, D is the pipe diameter, f is the wall friction factor, k is the corrugation height, E is the total energy head inside the pipe, U is the average velocity in the pipe and g is the acceleration due to gravity. Functional relationship of these variables is determined by model study. Model tests were made for various hole sizes and numbers of holes in the axial and circumferential direction. Also described is the method used to compute the pipe diameter and hole configuration necessary to obtain uniform spatial distribution of discharge for a given flow rate and head. (Upadhyaya-Vanderbilt)
W70-05788

THE INFLUENCE OF MIXING ON THE ACTIVATED SLUDGE PROCESS IN INDUSTRIAL AERATION BASINS,
Technische Hogeschool, Eindhoven (Netherlands).
S. P. P. Ottengraf, and K. Rietema.
Journal, Water Pollution Control Federation, Vol 41, No 8, Part 2, Aug 1969. p R282-R293, 9 fig, 9 ref.

Descriptors: *Activated sludge, *Aeration, *Waste water treatment, *Biological treatment, Mixing, Flow rates, Oxygenation, Industrial wastes.
Identifiers: *Aeration basins, *Residence time, *Plug flow, *Cascade mixers, Inka aeration system, Substrate-degradation, Foam waves, Radial mixing, Reaction rate, Auto-oxidation.

Kinetic insights have been obtained to enhance wastewater treatment in activated sludge installations. Experiments show that the hydraulic regime of the Inka aeration basin (an industrial rectangular sludge aerator) approximates that of a cascade of perfect mixers. The paper deals with residence time distribution in a rectangular sludge aerator; gives a model that describes the mixing mechanism; and analyzes the influence of mixing on the substrate degradation by the activated sludge process. Profiles are determined theoretically according to Monod equations for various types of mixing conditions. The measured residence time distributions in the rectangular aerator are compared with the theoretical distributions associated with a plug flow and with a cascade of perfect mixers. It appears that the theoretical model for plug flow does not afford a good description of the experimental results obtained. The results obtained with the model of cascade of perfect mixers agree favorably with the theoretical results. Theoretical derivations presented afford basic principles for the design of an aeration basin to achieve certain conversion. It is seen that plug flow reaction will give the highest conversion with respect to substrate degradation. However, plug flow reactors can be approximated by a cascade of perfect mixers. (Shankar-Texas)
W70-05797

PHOSPHATES IN SURFACE WATERS AND DETERGENTS,
Procter and Gamble Co., Cincinnati, Ohio.
P. J. Weaver.
Journal Water Pollution Control Federation, Vol 41, No 9, Sept 1969, p 1647-1653. 10 fig, 1 tab, 10 ref.

Descriptors: *Phosphorus, *Surface waters, *Detergents, *Eutrophication, *Nutrients, Phosphorus compounds.

Phosphorus has been labeled as the key to controlling eutrophication by those in a position to set the course for future action. Phosphorus can enter surface waters from many sources. Among the major sources there are: natural sources, such as, aquatic plants, bottom deposits, runoff from forest land; man generated sources from both domestic and industrial wastewaters; runoff from urban and agricultural areas. Several of these sources, particularly the natural sources will present complex problems in control. The control of phosphorus in wastewaters may be accomplished by several means: chemical processes, biological treatment, combination chemical-biological, and several miscellaneous processes including ion-exchange, electrodialysis and distillation. Detergents are discussed with emphasis upon the role of phosphorus. Phosphates are important ingredients of detergents for several reasons; they soften water, sequester objectionable elements, emulsify oils and greases, provide alkalinity, and disperse and suspend dirt. To date no substitute has been found that performs the role of phosphates in detergent, but has been and still is sought. (Morgan-Texas)
W70-05799

SYSTEM OPTIMIZATION OF WASTE TREATMENT PLANT PROCESS DESIGN,
Weston (Roy F.), Inc., West Chester, Pa.
Chia S. Shih, and John A. DeFilippi.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, N SA2, p409-421, April 1970. 7 fig, 5 tab, 5 ref.

Descriptors: *Costs, *Dynamic programming, *Optimization, *Sewage treatment, Mathematical models, Activated sludge, Trickling filter, Tertiary treatment.

A methodology of analysis is presented to produce a given treatment requirement of minimum cost. The methodology integrates dynamic programming techniques into present design principles to identify the optimal combination and efficiencies of various unit processes in a multi-stage plant. In this case optimal is defined as least cost. An advantage to the mathematical model is that it considers all unit processes at the same time for system optimization in contrast to the more common method of optimizing each unit process. An illustrative example is used in which the cost of a municipal treatment plant using primary clarification, secondary treatment (option of activated sludge or trickling filter) is minimized at $429,000. Using conventional design criteria the cost of the plant is calculated at $450,900. Cost curves are given for the unit processes employed in the plant and the point made that more reliable information concerning the cost and performances of unit processes is needed in order that treatment systems may be more effectively optimized. (DiFilippo-Texas)
W70-05800

THE PERFORMANCE OF CIRCULAR SEDIMENTATION TANKS,
Birmingham, Univ. (England).
T. H. Y. Tebbutt.
Water Pollution Control, Vol 68, No 4, p 467-474, July-Aug 1969. 7 fig, 7 ref.

Descriptors: *Sedimentation, *Hydraulic properties, Tracers, Settling basins, *Overflow, Rates, Sediment load, Suspended load.
Identifiers: *Solids removal.

Two 7.25-foot-diameter by 9.25-foot-deep sedimentation tanks, one of centerfeed design and the other peripheral feed, were operated side-by-side. The hydraulic properties and efficiencies, as determined by flow through curves using fluorescein tracer and the removal efficiencies, as determined by suspended solids and settleable solids, were determined at five surface overflow rates in the range of 480-3600 gal/sq ft day (Imperial gallons). The peripheral-feed tank removed slightly more suspended solids than the center-feed, but the differences were insignificant as compared to the variability of data. Due to increased flocculation at higher overflow rates, removal of suspended solids was found to be independent of overflow rate in the range tested, indicating that conventional surface loadings (600 gal/sq ft day) result in underloaded primary tanks. Hydraulic properties were found to be of limited value in assessing the removal of suspended solids. (DiFilippo-Texas)
W70-05801

LONGITUDINAL MIXING IN SPIRAL FLOW AERATION TANKS,
McMaster Univ., Hamilton (Ontario).
Keith L. Murphy, and Boris I. Boyko.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No SA2, p 211-221, April 1970. 6 fig, 11 ref.

Descriptors: *Dispersion, *Tracers, Activated sludge, Aeration, Sewage treatment.
Identifiers: *Plug flow, *Air flow, Detention time.

Rhodamine B tracer was introduced as a pulse into an aeration tank 270 ft long, 27 ft wide, and 15 ft deep. Tracer concentration was monitored in the effluent. Tests were performed using water from Hamilton Bay. Analysis of the tracer output curves indicated that the dispersion model described the longitudinal mixing in the tank. The dispersion coefficient was found to be independent of detention time in the range tested (4.8 to 13.3 hr). A correlation was determined between the dispersion coefficient and air flow rate in the range tested (6.4 scfm to 25.3 scfm per 1000 cu.ft. of tank volume). Both fine and coarse bubble diffusers indicated the same correlation. Analysis of data from tanks of various geometry indicated a correlation between the ratio of the dispersion coefficient and square of the tank width to the air flow rate. For a tank of conventional width and air flow rates of 15 scfm to 20 scfm per 1000 cu.ft. of tank volume the dispersion coefficient should range between 2000 and 8000 sq ft/hr. The degree of mixing existing in aerators with conventional air rates is such that they tend to approach fully mixed conditions. (DiFilippo-Texas)
W70-05802

PILOT PLANT TESTING FOR MUNICIPAL SEWAGE TREATMENT,
Killain (Elson T.) Associates, Millburn, N.J.
Robert C. Moore.
Journal of the Sanitary Engineering Division, ASCE Vol 96, No SA2, p 573-591, April 1970. 20 fig, 2 tab, 1 ref.

Descriptors: *Activated sludge, *Trickling filter, *Sewage treatment, New Jersey, Biochemical oxygen demand, Pilot plants, Biological treatment.
Identifiers: *Secondary treatment, Rahway Valley (NJ), Elizabeth (NJ).

An increase of treatment requirements to 80% removal of five-day BOD required that the 25 mgd Rahway Valley Sewage Authority, Rahway, New Jersey, and the 50 mgd joint meeting, Elizabeth, New Jersey, sewage treatment plants be converted from primary to secondary treatment. Due to industrialization the sewage is markedly different from domestic sewage and pilot plants were operated 1 1/2 years to analyze performance of both activated sludge and trickling filter. Actual trickling filter performances at both plants proved insufficient to meet effluent standards. The lowest efficiencies were observed at Rahway Valley and were believed due to a large amount of grease in the sewage. The activated sludge process proved capable of meeting the BOD standard at both plants. Periodic high alkalinity proved troublesome at the Joint Meeting, but the sources of highly alkaline wastes have been pinpointed. Design parameters arrived at include 59.5 lb BOD/1000 cu ft, suspended solids concentration of 2400 mg/l, and a food to micro-organism ratio of 0.4 at Rahway Valley. At the Joint Meeting values were 3100 mg/l suspended solids and a ratio of 0.29. The design is said to be conservative. (DiFilippo-Texas)
W70-05803

ALTERNATIVE METHODS OF FINANCING WASTE TREATMENT FACILITIES,
Union Securities and Co., New York.
W. James Lopp, II.
Journal Water Pollution Control Federation, Vol 42, No 2, p 291-297, Feb 1970.

Descriptors: *Appropriation, *Costs, *Financing, *Governments, *Interest, Legislation, Water quality, Water Quality Act, Treatment facilities, Taxes, Construction, Grants, Cities.
Identifiers: *Clean Waters Restoration Act of 1966, *Revenue bonds.

Except in the initial year (1966), the federal government has not fulfilled its authorization for appropriation. General obligation bonds, issued by local governmental units are usually restricted by constitutional, statutory or charter debt ceilings, etc. Alternate financing methods are presented to replace the unappropriated federal authorization. The proposed alternates are: first, FWPCA would transmit requitions to the Treasury Department which would be funded from the sale of second Liberty Bonds or a similar debt instrument. The limit would be the difference between amounts authorized and appropriated by Congress. The second is the establishment of two separate financing vehicles to handle federal and local governmental shares of the cost. The local government would issue its own tax-exempt bonds and the federal government would through the FWPCA sell obligations with taxable interest incomes. The third proposal involves complete local financing during construction and establishment of an independent agency to issue bonds to provide monies to retire a portion of the outstanding short-term debt; the balance would be retired from tax-exempt bonds issued by the local governmental units. Tax programs and financing methods for industrial waste treatment enacted at state levels are also cited. (Bishop-Texas)
W70-05804

TURBULENCE AND FLOCCULATION,
Technion - Israel Inst. of Tech., Haifa.
Yerachmiel Argaman, and Warren J. Kaufman.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No SA2, p 223-241, April 1970. 10 fig, 1 tab, 23 ref.

Descriptors: *Flocculation, Turbulent flow, *Coagulation, Waste water treatment, Kinetics, *Turbulence, Sewage treatment.
Identifiers: *Flocculation reactor, *Diffusion coefficient, Process design, Kaolin, Alum.

To design flocculation reactors, pilot plant test should be run to determine the configuration of the reactor, the geometry and power requirements of the stirring device, the concentration of the coagulant, and the need for floc strengthening additives. A theoretical model is presented for calculating the effectiveness of a continuous-flow reactor and validates the model with experimental test on a laboratory-scale reactor. The apparatus are four continuous-stirred tank reactors employing a suspension of 25 mg per l Kaolin powder (90% of the particles less than 40 microns) as turbid water and common filter alum (25 mg per l) as the flocculant. The results showed a minimum residence time for a given performance and an optimum value for the root mean square velocity gradient associated with a given residence time. Compartmentalization of the reactor reduced the residence time for a given performance with four compartments the residence time is about 800 sec and is 2000 sec for a single compartment. Anemometric measurements indicated a linear relationship between the mean square fluctuating velocity and the root-mean-square velocity gradient. (Waid-Texas)
W70-05805

DIFFICULTIES ASSOCIATED WITH SLUDGE DIGESTION, WITH PARTICULAR REFERENCE TO SYNTHETIC DETERGENTS,
D. W. Osborn.
Water Pollution Control, Vol 68, No 6, Nov-Dec 1969, p 662-663. 1 tab.

Descriptors: *Anaerobic digestion, *Detergents, *Sewage treatment facilities, Sludge digestion.
Identifiers: *South Africa, Mesophilic digestion.

A summary of eighteen replies received to a questionnaire circulated by the Southern African Branch to the larger local authorities in South Africa is presented. The average concentration of synthetic detergents in crude sewage was 15.1 mg/l (expressed as Manoxol OT) and 850 mg/l (range 250-3000 mg/l) in the digester contents. Some difficulties encountered included: increased volatile acids, frothing, scum formation, and odors. Also difficulties in maintaining the optimum pH and restarting digesters were noted. Work carried out by the British Water Pollution Research Laboratory indicated that over 2% detergents in a digester present serious inhibitory effects. However, in general, synthetic detergents cannot yet be incrimenated as a major source of difficulties with mesophilic digestion in South Africa. (Galwardi-Texas)
W70-05806

SLUDGE DENSITY CONTROL BY ULTRASONICS,
Southwest Suburban Sewer District, Normandy Park, Wash.
Edwin R. Sironen, and Dave Lee.
Journal Water Pollution Control Federation, Vol 42, No 2, p 298-301, Feb 1970. 4 fig.

Descriptors: *Sludge, *Pumping, *Control systems, *Sound waves, Automatic control, *Sludge

digestion, Waste water treatment, Washington, Ultrasonics, Sludge digestion.
Identifiers: Normandy (Wash), Miller Creek.

A 'sludge density controller' for control of the pumping cycle of sludge pumps to digesters was designed and installed at a wastewater treatment plant. The control device uses sound waves to sense the density of the pumped sludge, and stops the pumps when the percent solids drops below the desired value. This prevents the pumping of excess water into the digesters. The system includes an ultrasonic sensor and electronic control unit. The ultrasonic sensor contains a piezoelectric crystal transmitter and a receiver separated by a gap through which the sludge is passed. The ultrasonic sound waves transmitted across the gap are attenuated in proportion to the precent solids present. The electronic control unit activates the sensor and interprets the receiver output to control the pump relay, stopping the pump cycle when the sludge density drops below the desired percent solids. The initial design and subsequent modifications incorporated in the second model are described. The system is presently installed and operating trouble-free at the Miller Creek Sewage Treatment Plant, Normandy, Washington. The approximate cost of the unit installed is $465. (Morgan-Texas)
W70-05807

THE MANAGEMENT AND MAINTENANCE OF SMALL SEWAGE-TREATMENT WORKS,
Ronald G. Walker.
Discussion Included. Water Pollution Control, Volume 68, No 1, p 11-16, January-February 1969. 2 tab, 2 ref.

Descriptors: *Management, *Design, *Personnel, *Maintenance, *Operations, Sewage treatment, Wages, Effluent, Tertiary treatment, Sampling, Equipment.
Identifiers: *Small sewage treatment plants, Mobile gangs.

Many problems develop in the operation of small sewage treatment works because there is often no constant attention of a manager. To minimize problems, operators should keep accurate, concise records for review by the visiting manager or chemist, and management should be responsive to operators' requests. A record of running costs should be maintained, and annual reports prepared. Local districts should recruit and intensively train operators. To encourage recruitment, current wages should be raised, and working conditions improved. Local works should be stocked with sufficient and accessable equipment, and first-aid supplies should be provided. When employment of a full-time attendant is unfeasible, rotating maintenance gangs are preferable. Works should be designed to measure flows, periodically sample effluents, and produce high quality effluents in spite of variable flows. Equipment at periodically-manned works should be sturdy, simple and treated with anti-corrosive agents to minimize maintenance. Small works should provide tertiary treatment and selectively accept trade wastes to provide reliable quality effluents. (Cabe-Texas)
W70-05808

ECONOMIC ASPECTS OF SEWAGE WORKS DESIGN,
Elliott and Brown, Nottingham.
J. V. Cupit.
Water Pollution Control, Vol 68, No 2, p 166-177, March-April 1969. 5 fig, 5 tab, 4 ref.

Descriptors: *Sewage treatment, *Design, *Economics, *Annual costs, *Application, Methods, Capital costs, Interest rates, Rates, Labor, Maintenance costs, Insurance, Rent, Pumping plants, Sedimentation, Biological treatment, Activated sludge, Tertiary treatment, Sludge treatment, Sludge disposal, Trickling filters.
Identifiers: *Annuity, *Fuel and power costs, Material costs, Preliminary treatment.

The basic costs factors associated with the design of a sewage works are discussed, and the application of these cost factors to the design of individual units is considered. The concept of true cost is defined as the annual charge relative to a particular unit, and the major components of the annual cost are discussed. These include: loan debt charges; rents and rates; employment of labor; purchase of fuel and power; repair and maintenance of plant, buildings, and machinery; plant and machinery insurance; material purchases; and transportation. Consideration of the application of the cost factors includes discussions of the pumping plant, preliminary treatment units, biological treatment, tertiary treatment, and sludge treatment and disposal. Particular emphasis is placed on the topics of sedimentation, biological filters, and the activated-sludge process. General economic and engineering principles should be combined with the engineer's personal judgement in order to achieve a balanced solution of the design concept. (Denny-Texas)
W70-05809

THE TREATMENT AND CONTROL OF BLEACHING AND DYEING WASTES,
Cotton, Silk, and Man-made Fibres Research Association.
A. H. Little.
Water Pollution Control, Vol 68, No 2, p 178-189, March-April 1969. 9 fig, 3 tab, 2 ref.

Descriptors: *Textiles, *Industrial wastes, Neutralization, Sedimentation, Trickling filters, Activated sludge, *Biochemical oxygen demand, *Hydrogen ion concentration, Aeration.
Identifiers: Equalization.

The composition of textile waste liquors is studied and found to be highly variable in both flow and composition. This is due to both the variety processes in a plant and the fact that the processes are fill-and-draw. BOD and pH of waste liquors from 14 textile processes are given. Many treatment processes are discussed including: equalization, neutralization, segregation, sedimentation, and biological treatment. Neutralization can be achieved by sulfuric acid addition or carbonization with flue gas. A cascade system of neutralization tanks is necessary for proper control of pH. It may be desirable to segregate especially strong liquors or liquors toxic to biological treatment. Sedimentation in fill-and-draw tanks is desirable to continuous flow, while alum or copper as addition will improve sedimentation. A plant scale mechanical aeration biological filter plant achieved BOD reductions usually in excess of 80 percent. Average untreated BOD was 166 mg/l (range 55-354) while treated averaged 39 mg/l (range 1-289). A diffused air plant gave similar data while trickling filters of slag and Flocor medium had not been operated long enough for results. (DiFillippo-Texas)
W70-05810

NITRIFICATION,
Water Pollution Research Lab., Stevanage (England).
S. H. Jenkins.
Water Pollution Control, Vol 68, No 6, p 610-618, Nov-Dec, 1969. 8 fig, 4 tab, 4 ref.

Descriptors: *Activated sludge, *Nitrification, *Sewage, *Temperature, *Retention, Dissolved oxygen, Aeration, Industrial waste, *Biochemical oxygen demand.
Identifiers: *Nitrosomonas, *Suspended solids, Birmingham (England), Growth constants.

It is important to remove ammonia nitrogen during sewage treatment to reduce the oxygen demand on the receiving water. In the activated sludge process the nitrifying bacteria must be maintained at a certain number to obtain constant conditions of nitrification. Wash out of these bacteria was measured with nitrosomonas. It was found to occur when the retention period or the concentration of activated sludge was low and carbonaceous BOD was high. To predict whether or not nitrification would occur the mass of solids forms per unit mass of BOD in the sewage and the growth constant of the nitrifying bacteria was determined. An equation was derived utilizing different values of these parameters to determine if nitrification could occur. A high degree of nitrification was obtained with a retention period of 4 hours and 2000 and 6000 mg/l of mixed liquor suspended solids. Decreased nitrification was noted within 2 days when 2000 mg/l of mixed liquor solids were held for only 2-5 hours, however with 6000 mg/l of solids nitrification was complete in the 2 hour period. Growth constants were determined for nitrosomonas growing in activated sludge systems and different polluted waters, some enriched with activated aludge. The aeration period required for nitrification was reduced by increasing the temperature of the process or increasing the solids in the mixed liquor. (Schaub-Texas)
W70-05811

INHIBITION OF SLUDGE DIGESTION BY SYNTHETIC DETERGENTS,
Water Pollution Research Lab., Stevenage (England).
J. D. Swanwick, A. M. Bruce, and K. G. Vandyke.
Water Pollution Control, Vol 67, No 1, 1968, p 91-99. 5 fig, 3 tab, 16 ref.

Descriptors: *Inhibition, *Sludge digestion, *Alkylbenzene sulfonates, Methane bacteria, Industrial wastes, *Detergents, *Surfactants.
Identifiers: Amine.

A summary of the investigations on the inhibitory effect of synthetic detergents on the digestion process and the successful development of remedial measures is presented. Laboratory tests conducted on a domestic sludge showed that the high detergent content of the sludge was the most likely cause of difficulties in its digestion and that digestion was not reliable if the detergent content of the feed sludge was about 2%. Experiments were also conducted to compare the effects of hard and soft detergents. The test indicates that no significant proportion of either the soft or hard detergent was destroyed during digestion. The relationship between detergents and sludge solids is also illustrated briefly. Amine treatment is adopted to solve the above problem. Tests and their results are discussed. Laboratory digesters are operated under uniform conditions, whereas sewage work digesters are subjected to fluctuation in operating conditions such as temperature and other factors, all of which can lead to overloading of the methane bacteria. Reduction in the acitvity of methane bacteria in the presence of detergents may permit a rapid increase in the concentration of volatile acids leading to digester failure. Such difficulties could be overcome by the addition of amine, at a low cost. (Shankar-Texas)
W70-05812

SOLVING THE DETERGENT PROBLEM IN GERMANY,
W. Husmann.
Water Pollution Control, Vol 67, No 1, 1968, p 80-90, 3 fig, 5 tab.

Descriptors: *Detergents, *Degradation, *Sewage treatment, *Legislation, Biological treatment, Cleaning.
Identifiers: *Non-ionic detergents, Foam, Inland waters.

The law on detergents used in washing and cleansing products promulgated on 5th Nov. 1969 by the German Bundestag came into force on 1st October 1964. The law specified that anionic detergents in washing and cleansing products must be at least 80 percent degradable. From 1962-1964, when hard detergents were being used, the samples taken before and after treatment in the purification stations, showed an average degradability of only 22 percent. The new detergents (soft-detergents) indicated more than 80 percent degradability. From the results obtained in the sewage treatment

plants and in the inland waters, it was found that methods adopted by Federal Republic of Germany to solve the detergent problem has led to the expected success. The paper stresses the point that the problems of detergents can only be finally solved, if biological purification installations are built in and are used according to the regulations for all household and industrial wastes containing detergents. It is also necessary that the efforts to solve the detergent problem should not be hampered by the importation of washing products containing hard detergents. (Shankar-Texas)
W70-05813

DEVELOPMENT OF SYNTHETIC DETERGENTS BASE MATERIAL,
Shell Chemical Co. Ltd., London (England).
R. C. Tarring.
Water Pollution Control, Vol 67, No 1, 1968, p 59-65. 1 fig, 13 ref.

Descriptors: *Detergents, *Biodegradation, Sewage, Effluents.
Identifiers: *Surface active agent, *Liquid detergents, Subsidiary constituents, Legislative control.

The development of synthetic detergent during the past 25 years to encourage and assist the co-ordination of appropriate research by manufacturers of detergents and intermediate materials is emphasized. The surface active agent which is the basis of all detergent formulations is given careful consideration, at the beginning. Sodium secondary sulphate and other products which assume major importance as surface active agents, served a very useful purpose during the years 1942-1945. Research has led to the development of a new basic surface active agent, namely sodium dodecyl benzene sulfonate. With the advent of more efficient household detergents, there was a tremendous development in the rate of sales of these products especially in the 1950's. It was found that early synthetic detergents based on alkylsulphates interfered with the sewage treatment. The biodegradability of these detergents is then discussed. Mention is also made of liquid detergents and subsidiary constituents. Further research work carried out in the synthetic detergents provide a great deal of very useful cata which contribute to a better understanding of the sewage processing which have a strong influence on the design and opeartion of sewage works in the future. (Shankar-Texas)
W70-05814

ASSESSMENT OF BIODEGRADABILITY,
Water Pollution Research Lab., Stevenage (England).
G. E. Eden, G. A. Truesdale, and G. V. Stennett.
Water Pollution Control, Vol 67, No 1, 1968, p 107-123, 5 fig, 4 tab, 14 ref.

Descriptors: *Biodegradation, *Alkylbenzene sulfonates, Biochemical oxygen demand, Incubation, Sludge, *Detergents.
Identifiers: *Pilot-scale test, *Inoculum, Open-vessel test, Substrate concentration, Non-ionic detergent.

The need for proper assessment of aerobic biodegradability of synthetic detergent is emphasized. An incubation test originally using river water and later using synthetic BOD dilution water in both cases with a suitable inoculum was used to simulate the degradation of detergent during passage down a river. A considerable number of materials of commercial interest were used in the incubation tests and the results were in close agreement. With soft detergents the results were in good agreement with the results of more eloborate tests conducted in pilot-scale sewage treatment plants. With hard detergents such as Dobane PT, agreement was less good. Open vessel tests using standard BOD dilution water and various clean river-waters as diluents and using 5 ml/l of sewage effluent as inoculum, indicated that while with BOD water the acclimatization or lag period tended to be longer more consistent results were obtained. The need for a supplementary test based on the activated sludge process to which materials fail to reach the required level of degradability in the aeration test is also stressed. (Shankar-Texas)
W70-05815

AN EXPERIMENTAL STUDY OF THE ROLE OF THE CILIATED PROTOZOA IN THE ACTIVATED SLUDGE PROCESS,
Water Pollution Research Lab., Stevenage (England).
C. R. Curds, A. Cockburn, and Jennifer M. Vandyke.
Water Pollution Control, Vol 67, No 3, 1968. p 312-329, 14 fig, 3 tab, 13 ref.

Descriptors: *Bacteria, *Activated sludge, *Flocculation, Biochemical oxygen demand, Chemical oxygen demand, Biomass, Turbidity, Protozoa.
Identifiers: *Ciliates, Suspended solids, Synthetic sewage, Domestic sewage, Aeration tank, Sedimentation tank.

Experimental methods have been adopted to determine the effect on the quality of the effluent of the addition of ciliated protozoa to protozoa-free activated sludges. The experiment is conducted in a pilot-plant using synthetic sewage as the feed. A significant drop in the number of bacteria and quantity of non-settlable suspended solids in effluents following the introduction of ciliates is observed. It is also observed that there is an increase in the removal of soluble organic complexes when ciliates are present. A second experiment was conducted using Stevenage domestic sewage to verify the results of the first experiment. The results as assessed by the following criteria, i.e., COD, the permanganate value and others proved that the results obtained in the synthetic sewage were valid. It was finally concluded that high quality of the effluents following introduction of the ciliates might be due to one of the two factors, namely that the bacteria are the food products of ciliates and secondly that ciliates have the ability to flocculate suspended matter and bacteria. It is not yet clear which of these two factors is the more important. (Shankar-Texas)
W70-05816

BIOLOGICAL FILTER WALLS: THE TEMPERATURE PROBLEM AND ITS SOLUTION,
Department of Sewerage, Johannesburg (South Africa).
R. I. Jackson.
Water Pollution Control, Vol 67, No 3, 1968. p 338-354, 12 fig, 1 tab, 16 ref.

Descriptors: *Temperature, *Tension, *Expansion, Movement, Reinforced concrete, Cantilevers, Costs, *Trickling filters.
Identifiers: *Biological filtration, *Ring-tension wall, Stone medium, Bending stress.

The reason for the high frequency of failure of biological filter walls is determined and a design is presented to avoid failure of walls in the future. Designers have recognized that the circular wall expands at high temperature, the retained stone moves forward against the wall, and subsequent contraction of the wall is resisted by the retained stone. It is observed that coefficients of thermal expansion of concrete vary with the aggregate used. Examination of the effect of temperature variation on wall tension showed that cycles of temperature changes cause cycles of wall movement away from and towards the stone fill. Movements towards the fill tend to mobilize passive pressure which can be up to sixteen times active pressure. Hence the inward movement is always less than the outward movement for the same temperature change. Repeated cycles result in progressive movement and an escalation of tension in the wall. The above problem could be solved by building a wall as a series of isolated walls, cantilevering from the base. A procedure is presented for designing different types of walls for biological filters. A less sophisticated and less expensive, is the simple vertical cantilever wall in isolated lengths with expansion gaps. (Shankar-Texas)
W70-05817

INCREASING WASTEWATER FLOW VELOCITY BY USING CHEMICAL ADDITIVES,
Western Co. of North America. Richardson, Tex. and Southern Methodist Univ., Dallas, Tex.
J. L. Overfield, H. R. Crawford, J. K. Baxter, L. J. Harrington, and I. W. Santry, Jr.
Journal of the Water Pollution Control Federation, Vol 41, No 9, Sept 1969. p 1570-1585, 17 fig, 1 tab.

Descriptors: *Additives, *Flow rate, *Waste water, *Algae, *Sludge, Storms, Turbulence, Pilot plants, Bacteria, Sedimentation, Toxicity, Cost-benefit analysis.
Identifiers: *Polymers, *Biological life, *Algae blooms, *Fish toxicity test, Sludge drying, Solids-settling, Economic advantage, Temperature-effect.

Practical methods have been developed to increase waste water flow velocity by using chemical additives without increasing the energy needed to move the liquid. Existing sewer line flow can be increased by using polymer additives that would increase the solid removal effectiveness at treatment plants. A 100 ft long 6 in sewer line test facility along with 25,000-gal controlled-temperature reservoir is used to determine the increased water flow with addition of chemical additives. There is a rapid increase up to 24 times the normal flow. Flow could be increased by a factor of 2 or more by using concentrations of additives between 45 and 200 ml/l. The cost/benefit analysis for a given example shows that the cost of rectifying overflow from a constriction by using an additive injection system, is less than half the prorated cost of constructing a parallel pipe system to relieve the condition. However, if the overflows occur ten times a year, the additive injection system becomes more expensive. Biochemical studies conducted indicate that additives do not affect adversely the waste water bacteria, fish, or promote algae growth. Further, the additives improve waste water settling and sludge drying rates. Additive injection system, through preferable economically in many cases, cannot be applied as a long term solution. (Shankar-Texas)
W70-05819

THE DESIGN, CONSTRUCTION, AND OPERATION OF EXTENDED-AERATION PLANTS,
Peters, G. D. (Engineering) Ltd.
B. Storch.
Water Pollution Control, Vol 68, No 1, p 40-50, Jan-Feb 1969. 4 ref.

Descriptors: *Activated sludge, *Operation and maintenance, *Design, *Construction, Aeration, Waste water treatment, Aerobic conditions.
Identifiers: *Extended aeration, Aerobic digestion.

The design of an extended aeration plant is discussed including: inlet, aeration tank, aeration to settling transfer, inlet to settling tanks, settling tank, sludge return, surface skimming, effluent withdrawal, and excess sludge handling. Excess sludge handling is treated at length including aerobic digestion. Physical descriptions and recommended dimensions for various components and equations for several calculations are given. Recommendations are made for materials to be used, positioning of equipment and other facets of construction. Plant start-up is described and a checklist for operation and maintenance is given. (DiFilippo-Texas)
W70-05820

AN INVESTIGATION INTO UPWARD-FLOW FILTRATION.
West Hertfordshire Main Drainage Authority, Rickmansworth (England).
Richard Wood, William S. Smith, and J. K. Murray.

Water Pollution Control, Vol 67, No 4, 1968. p 421-428, 3 fig, 7 tab, 2 ref.

Descriptors: *Sewage treatment, *Filtration, *Biochemical oxygen demand, *Activated sludge, Biological treatment, Pilot plants, Humus, Reaeration, Effluents, Flow rates, Filters, Algae.
Identifiers: *Upward flow, Putrescibility test, Body Immedium filter, Back-washing.

Sewage treatment authorities are increasingly being required to produce higher quality effluents from increasing volumes of stronger sewages. Enlarged activated sludge plant is designed to produce fully nitrified effluent of low solids content, to which could be added additional activated sludge solids. This makes it possible to carry out an investigation of upward-flow sand filtration. A Body Immedium filter is used to determine the effectiveness in filtering a high-quality effluent containing a wide range of activated sludge concentrations. Satisfactory removals of coarser activated sludge are obtained. By dosing the filter with artificially high proportions of well-oxidized activated sludge, high percentage removals are obtained. Although the unit is manually controlled, this type of filter lends itself to automated operation and provided that the feed liquor is of high quality and only contaminated with solids, very high quality effluents can be produced. (Shankar-Texas)
W70-05821

A SECOND-ORDER EQUATION, NOT BASED ON ULTIMATE OXYGEN DEMAND, DESCRIBING THE FIRST PHASE OF OXYGEN UPTAKE IN BIOCHEMICAL OXYGEN DEMAND REACTIONS,
Newcastle-upon-Tyne Univ. (England).
James R. Simpson.
Water Pollution Control, Vol 67, No 4, 1968. p 433-453, 14 fig, 2 tab, 12 ref.

Descriptors: *Biochemical oxygen demand, *Bioassay, *Biological treatment, *Respiration, Equilibrium, Microorganisms, Metabolism.
Identifiers: *Oxygen uptake, *Oxidation/synthesis, *Respirometer, Confined growth, Normal growth, Suspended solids.

The use of respirometer systems for the determination of oxygen-demand values of waste waters and aerobic biological systems are discussed in detail. The respirometer described has good sensitivity and great ease for withdrawing samples for analysis during a run. Reproducibility of results from settled sewage is excellent, with a maximum difference of 1.11 percent from the mean at 120 hours. A second order equation, not based on ultimate oxygen demand, describing the first phase of oxygen uptake in biochemical oxygen demand reactions is proposed. The proposed formula relating the rate of reaction to the substrate concentration and to the population of organisms, gives an excellent fit to the observed data for the first part of the reaction. The significant feature of the formula is that the ultimate oxygen demand is not required but the removable oxygen demand must be determined. In the given formula the value of a conversion constant is a function of the substrate and the organisms effecting treatment. When the values of the constants and the overall rate of metabolic processes have been determined for various systems, the critical oxygen uptake value and the time when it occurs can be calculated from a minimum of data obtained from the beginning of an experiment. (Shankar-Texas)
W70-05822

THE DESIGN AND OPERATION OF A PLATING WASTE TREATMENT PLANT,
Flight Refueling Ltd., Wimborne (England).
M. Tanner.
Water Pollution Control, Vol 67, No 4, p 401-406, 1968, 4 fig.

Descriptors: *Waste treatment, *Design, *Flow rate, Sewage, Ion exchange, Additives, Wetting, Sludge, *Treatment facilities, Settling basins, Demineralization.
Identifiers: *Contamination level, *Rinse tanks, Settlement tanks, Automatic dosing, Carbon filtration, Wetting agents, Plating waste.

Specific design and operational problems are discussed in the treatment of effluent discharges from a plating factory at Wimborne. Initially, contamination levels were prescribed and direct discharge into the sewerage system was authorized. Then consideration was given to the direct treatment of waste at the factory. Contamination levels in the waste and the quantity of the water required for the treatment were calculated. Ion-exchange resin treatment plant was chosen for the treatment of the waste. Treatment of cyanide waste which cannot be done with ion-exchange resin was carried out at the second part of the plant, by dosing with 5% lime slurry to adjust the pH to 11 and, this is followed by another chemical treatment. After settlement of the sludge overnight, dewatering of the sludge is accomplished in separate holding tanks and the clear supernatant water is passed on to the sewer. Efficiency of this ion-exchange system over shadows its high cost. The savings in water alone amounts to 5, 400,000 gallons per year. Further, settlement of the sludge overnight enables the small amount of effluent to be discharged at a slow rate giving better dilution with the sewage. Another advantage of treating plating waste is that the use of de-ionized water for make-up of baths and in rinsing tanks gives better quality plating and easier maintenance of equipment. (Shankar-Texas)
W70-05823

PLANT-SCALE POLYELECTROLYTE TREATMENT OF WASTEWATER USING STREAMING CURRENT CONTROL,
Robert S. Kerr Water Research Center, Ada, Okla; Dow Chemical Co., Midland, Mich; West Virginia Univ., Morgantown; and Illinois Inst. of Tech., Chicago.
Charles P. Priesing, Ralph V. Wolfe, William A. Sack, and Sheldon Kelman.
Journal Water Pollution Control Federation, Vol 41, No 8, Part 1, Aug 1969. p 1524-1532, 13 fig.

Descriptors: *Waste water treatment, *Sludge digestion, Biochemical oxygen demand, Feeding rate, Sampling, Flocculation, Instrumentation.
Identifiers: *Polyelectrolytes, *Streaming current, *Detector, Automatic, Waste water sample system, Feeding system, Hydraulic flow.

Determination is made on the applicability of an automated streaming current detector (SCD) to control the feeding of the polyelectrolyte in a full-scale operation, and specifically, the degree of treatment attainable with a flocculant (the Dow Chemical Company's Purifloc R (registered trademark) C31) at various pre-selected streaming current detector readings. A 450-gal automatic dilution and storage system is used for flocculator feed at a 50-mgd chemical coagulation plant with separate sludge digestion. Streaming current detector (SCD) senses the waste H2O flow and transmits electrical signal, to a variable speed drive unit which drives the polyelectrolyte solution delivery pumps. The raw waste water samples are analyzed for carbon concentration while the effluent samples are analyzed for carbon concentration and biochemical oxygen demand. Effluents containing 50 mg/l BOD and 42 mg/l carbon were obtained at a streaming current reading of 0. Sampling techniques used in the study are explained. Lower doses of flocculant are required in full-scale plant than in the laboratory sutdies. (Shankar-Texas)
W70-05825

PYROLYTIC ANALYZER DETECTS ORGANIC MATTER IN WASTEWATERS,
North American Rockwell Corp., Canoga Park, Calif; and Los Angeles Bureau of Sanitation, Calif.
Kurt H. Nelson, Ilhor Lysyj, and Joe Nagano.
Water and Sewage Works, Vol 117, No 1, p 14-18, Jan 1970. 6 fig, 3 tab, 7 ref.

Descriptors: *Waste water treatment, *Organic matter, *Volatility, *Effluents, *Laboratory equipment, *Biochemial oxygen demand, *Chemical oxygen demand, Treatment facilities, Operational, Pre-treatment (Water), Organic loading.
Identifiers: *Pyrolysis, *Pyrolytic analyzer, *Organic analyzer, *Instrument design, *BOD5 test, Hydrogen-flame ionization detector, Raw sewage, Primary effluents, Secondary effluents, Hyperion Treatment Plant (Los Angeles), Fuctionality tests.

Operation of wastewater treatment plants needs rapid acquisition of data on essential parameters and variables including the organic load in the process stream. The organic load can be quickly measured with a new instrument designed on the principle of fragmentation of the organic matter by direct pyrolysis in the presence of water. The measurable volatile organic fragments produced are summed with a detector specific for organics. These data can be converted expressed as BOD through calibration. The primary advantage of the organic analyzer for measurement of the organic load is its capability for instantaneous or continuous data acquistion, and elimination of extensive sample preparation or pretreatment. The simplicity and compactness of the instrument is an added major advantage. A series of four to six injections into the pyrolysis chamber is adequate for waste water analyses. Field tests of the pyrolytic analyzer were made on raw sewage samples primary and secondary effluents at the Hyperion Treatment Plant, Los Angeles, California. Pyrolytic analyzer results were compared to regular BOD5 test results. For the raw sewage tests the average difference was 4.1%; for primary effluents-6.8%; for secondary effluents-the pyrolytic results average about twice the BOD5 results. Possible reasons for discrepancies are discussed. (D'Arezzo-Texas)
W70-05826

SOME EXPERIENCES IN THE CONSOLIDATION OF SURPLUS ACTIVATED SLUDGE,
Manchester Corp. (England). Rivers Dept.
Peter Brown, and Alan Thomas.
Water Pollution Control, Vol 68, No 2, p 203-211, March-April, 1969. 2 fig, 6 tab, 4 ref.

Descriptors: *Activated sludge, *Sludge disposal, Consolidation, Centrifugation, Flotation, Heat treatment, Sludge treatment, Sludge digestion, Sludge.
Identifiers: *Polyelectrolytes, Davyholme Works, Supernatant, Manchester (England).

Increasing the proportion of activated sludge solids at the 68 MGD Davyholme Works of the City of Manchester from 17 to 46 percent resulted in thinner sludges being obtained from the sedimentation tanks due to a reduction in the amount of supernatant. A survey was made of methods to reduce sludge volumes including: polyelectrolyte flocculants, pressure flotation, centrifugation and heat treatment. Polyelectrolytes increased the settling rate of both digested and activated sludge, but had no effect on ultimate solids control. Pressure flotation yielded sludge solids contents of 2.5 to 5.0 percent. Several centrifugation methods produced sludges of between 8 and 10 percent solids. Heat treatment followed by 24 hours of settling produced sludges of 7.7 to 12.2 percent solids. Modification made on the plant was to divert excess activated sludge from the primary settling tanks to separate consolidation tanks using periodic sludge withdrawal. The consolidated activated sludges contained 6.5 percent solids. The activated sludge used in the trials had treated sewage containing large amounts of chemical wastes. (DiFilippo-Texas)
W70-05827

OPERATOR CERTIFICATION AND TRAINING IN THE UNITED STATES OF AMERICA,
Water Pollution Control Federation, Washington, D.C.
Ralph E. Fuhrman.
Water Pollution Control Vol 68, No 5, p 556-559, Sept-Oct 1969, 2 ref.

Descriptors: *Training, *Waste water treatment, *Operations, Standards, Regulation, Schools (Education), Treatment facilities, Permits.
Identifiers: *Voluntary certification, *Mandatory certification, Plant operation, Operator.

Efficient water pollution control depends upon good operation of the treatment plant. Certification of operators is either voluntary or mandatory in states which have certification programs. At best only about 50 percent of the operators can be certified with a voluntary program. Mandatory programs benefit the state agency, employer, and employee. Program problems include the time required, legislation, agreement among proponents, manpower and money for administration and training, support of authorities, and a reserve of trained operators during establishment of a program. Training in Illinois has an informal approach with on-the-job training. Texas holds annual short schools and short schools throughout the State at or through Texas A and M University. Certification can raise the performance level of operators and provide many benefits through good plant operation. (Berryhill-Texas)
W70-05828

THE ROLE OF CONTACT STABILIZATION IN THE TREATMENT OF INDUSTRIAL WASTE WATER AND SEWAGE: A PROGRESS REPORT,
Water Pollution Research Lab., Stevenage (England).
A. G. Boon.
Water Pollution Control, Vol 68, No 1, p 67-84, Jan-Feb, 1969. 5 fig, 9 tab, 19 ref.

Descriptors: *Waste water treatment, *Pilot plants, *Industrial wastes, Sewage, Activated sludge, Sludge treatment, Effluents, Nitrification, Biochemical oxygen demand, Chemical oxygen demand, Dairy industry.
Identifiers: *Contact stabilization, *Biosorption, Milk products waste, Spent metabolite, Solids concentration.

Waste water from a milk products factory and from a factory producing antibiotics by the fermentation process can be partially treated by the contact stabilization process. Pilot plant operations showed that waste water from the milk plant could be treated with average BOD removals of about 65 percent. The same pilot plant was used to treat waste water containing spent metabolite. Average BOD removals ranged from 50 to 86 percent at loadings of 0.63 to 0.34 kg BOD/kg sludge-day, respectively. Treating domestic sewage two pilot plants operated in parallel using the 'conventional' activated sludge process and the contact stabilization process gave similiar results for both methods. Loadings, suspended solids, retention times, sludge volume index, and other data are shown for all cases. Depending on the composition of the waste water and the degree of treatment desired, a careful balance between periods of contact and reaeration times should be made for the contact stabilization process. (Berryhill-Texas)
W70-05829

A NEW APPROACH TO OPERATOR TRAINING,
Sacramento State Coll., Calif.; and Santa Ana Watershed Planning Agency, Calif.
Kenneth D. Kerri, and Bill B. Dendy.
Journal Water Pollution Control Federation, Vol 42, No 2, Part 1, p 190-194, February 1970, 2 tab, 2 ref.

Descriptors: *Waste water treatment, *Training, *Operations, Effluents, Standards, Regulation.
Identifiers: *Sacramento (Calif), *Plant operation, Operator, Techniques, Homestudy.

Increasing numbers of waste water treatment facilities have created the need for a training program to help meet the skilled manpower shortages, water quality standards, and demands that plants be operated at design efficiencies. A Federal Water Pollution Control Administration grant made possible an investigation of a homestudy type training program for operators. Prepared lessons emphasize operation to meet established water quality standards and protection of the beneficial uses of the receiving waters. Operators participating proceed through one section of the lessons, answer questions, reread as necessary for a clear understanding and then proceed. Participants in the program receive occasional personal contact by the administering agency to relate the lessons to actual plant operation. Program has not been completed and evaluated as of February, 1970. (Berryhill-Texas)
W70-05830

IMPROVEMENTS IN FINE-BUBBLE AERATION FROM THE STANDPOINTS OF TECHNIQUE AND OPERATION,
Schumacher Filters Ltd., Bietigham (West Germany).
C. G. Beuthe.
Water Pollution Control, Vol 68, No. 1, p 51-58, Jan-Feb, 1969. 4 fig, 2 tab, 1 ref.

Descriptors: *Activated sludge, *Aeration, Oxygen demand, *Biological treatment, Sewage treatment.
Identifiers: *Completely mixed, *Piston flow, *Constant hydraulic loading, *Sludge loading, Diffusers, Surface aerators.

Three methods of applying the activated sludge process: (1) completely mixed, (2) conventional or piston flow, and (3) distributed sewage feed were investigated. The effects of sludge concentration, sludge loading (BOD: sludge solids ratio), and residual pollution was considered. A distribution function describing the sewage feed necessary to obtain a constant sludge loading was developed. Two plants, a piston flow process and a distributed feed process, equipped with tubular diffusers were examined to check the theoretical considerations. The results indicate that longitudinal flow, constant sludge loading and tapered aeration is required for maximum efficiency of oxygen input. Practical application of the longitudinal flow with constant sludge loading is described. Oxygen input using fine bubble aerators was shown to be equal in both sewage and clean water when the effluent is well purefied (partially nitrified) but is 10 to 20 per cent less in sewage when the effluent is only partially purified. The oxygen input was determined from the oxygen demand of the initial and final products. The relationship between oxygen demand and the degree of purification is also presented. Comparisons of fine bubble aeration and surface aeration indicates that during periods of low pollution input, the fine bubble aeration system is superior because of the lower energy required for mixing. (Bishop-Texas)
W70-05831

SOLIDIFICATION OF SLUDGES WITH PORTLAND CEMENT,
Clarkson Coll. of Technology, Potsdam, N.Y.
E. Alan Cassell, and Thomas W. Walker.
Journal of the Sanitary Engineering Division, Proceedings of the ASCE, Vol 96, No SA1, p 15-26, February 1970. 7 fig, 7 tab, 13 ref.

Descriptors: *Sludge disposal, *Portland cements, *Fly ash, Compressive strength, Phosphorous, Leaching.
Identifiers: *Animal wastes, *Solidification, Bleed water, Primary sludge, Solid matrix.

Raw primary sewage sludge and chicken manure sludge were mixed with various amounts of portland cement and fly ash and allowed to cure. The technique immobilizes the sludge in a solid matrix which can be easily disposed. Data showed that it is possible to proportion mixes to produce a solid matrix of widely varying characteristics. The ratio of weight of water to cement varied from .5 to 10.55 and generally higher ratios results in: longer times to set, larger quantities of bleed water, and lower compressive strengths. The ratio by weight of sludge to cement varied from 0.0 to 0.5 and generally higher ratios resulted in: longer times to set, smaller quantities of phosphorous leached. The ratio by weight of fly ash to sludge varied from 0.0 to 8.0 and generally higher ratios resulted in: shorter times to set, and lower quantities of bleed water. Maximum phosphorus leached in a 15 day period amounted to 3.3% of the total phosphorous in the sludge. (DiFilippo-Texas)
W70-05832

THE METAZOA OF WASTE TREATMENT PROCESSES-ROTIFERS,
Florida Univ., Gainesville.
W. T. Calaway.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R412-R422, Nov. 1968. 3 fig, 0 tab, 23 ref.

Descriptors: *Activated sludge, *Rotifers, *Microbiology, *Efficiencies, Treatment, Waste treatment, Trickling filter, Sewage treatment, Animals, Waste water treatment.
Identifiers: *Metazoa.

Different waste water treatment processes develop different characteristics fauna. The activated sludge process commonly supports Rotifers as its principal metazoa, trickling filters support populations of rotifers, round worms, and annelids, and the metazoa of lagoons very widely. Although the metazoa sometimes cause treatment problems they consume large amounts of bacteria and solids and therefore are generally helpful in treatment. They also break up biological masses and expose new areas to oxygen. The rotifers aid in keeping an actively growing bacterial population by consuming bacteria and thereby encouraging replacement growth. By consuming unflocculated bacteria, the rotifers contribute to clearer effluence. Their secretion can also contribute to flocculation of suspended materials. The bdelloid rotifers dominate as process stability is approached. (DiFilippo-Texas)
W70-05853

INDUSTRIAL USES OF NON-IONIC SURFACE-ACTIVE AGENTS,
Imperial Chemical Industries Ltd., Brixham (England).
J. H. Cruickshank.
Water Pollution Control, Vol 67, No 1, 1968, p 100-106. 1 fig.

Descriptors: *Structure, *Properties, *Biochemical oxygen demand, Surface tension, Textile, Effluents, Emulsion, Surfactants, Detergents.
Identifiers: *Non-ionic surface active agents, *Residues, *Synthetic fiber, Dyeing, Printing-process, Polymerization.

A brief outline of the properties and the industrial uses of non-ionic surface active agents is presented. Mention is made of structure and constitution of non-ionic surface-active agents. Non-ionic surface active agents have inherent advantage over anionic agents in three major respects; (1) they are less affected by high concentration of electrolytes, (2) degree of solubilization conferred by the polar groups can be varied in smaller steps, and (3) readily soluble in non-aqueous media. The removal of residues of non-ionic surface active agents in the factory effluent by biological treatment is discussed well. Non-ionic surface active agents have proved to be useful in specialized dyeing and printing process. It also finds its application in synthetic fiber industry, paper and leather industries and other industrial places. It is thought that the consumption of 100% non-ionic active agents in the U.K. in industrial uses is about 10,000 tons/year. However it should be emphasized that they comprise a relatively small part of the total tonnage of the surface active agents used by industry. (Shankar-Texas)
W70-05854

THE DESIGN OF TRADE WASTE TREATMENT PLANTS,
General Engineering Co. (Radcliffe) Ltd. (England).
J. Novak.
Water Pollution Control, Vol 67, No 3, 1968. p 257-267, 2 fig, 1 tab.

Descriptors: *Design, *Waste treatment, *Biological treatment, *Costs, Instrumentation, Settlement, Flocculation, Disposal, Industrial waste.
Identifiers: *Effluent treatment, Running swills, Chemical treatment, Neutralization, Sludge collection, Sludge dewatering.

The design aspect of a treatment plant to deal with the effluent from an electroplating shop is emphasized. The first step in designing an effluent treatment plant is the collection and analysis of representative samples of the effluent. The next step is to prepare several flow diagrams and to roughly estimate the cost of each scheme, and then select the best one. Decisions should be made on the number of separate drainage systems and then collection and conveyance of raw effluents should be considered. Having decided on the separate treatments, the designer must ascertain the individual flow rates and degree of contamination. The required degree of automation for the treatment plant is then decided. Wastes containing cyanide and chromium generally require separate pretreatment. The treated and neutralized liquors should comply with local authority requirements. Settling tanks are used to remove suspended solids, and pH of the supernatant liquors is measured before entering the sewer. The problems stated above do not deal with all the aspects of design or with all the types of effluents encountered. (Shankar-Texas)
W70-05855

PH INSTRUMENTATION AND AUTOMATION IN THE TREATMENT OF TRADE WASTES,
A. C. Stewart.
Water Pollution Control, Vol 67, No 3, 1968. p 265-268, 3 ref.

Descriptors: *Instrumentation, *Automation, *Electrodes, Industrial waste, Hydrogen ion concentration.
Identifiers: *Dip-type electrode, *Flow-type electrode, Redox-controller, Reagents.

A clear description of the control instruments available and useful advice on the selection and application of neutralization agents for the control of pH is presented. The dip-type electrode system which is described is suitable for applications where the velocity of the liquid is low. The flow-type electrode system gives less trouble as the electrodes are mounted on the top of the sampling chamber. But in this, time delay taken for the liquid to reach the electrodes is sometimes unacceptable. The paper further discusses the pH meter as a device for transforming a purely static voltage into an equivalent value of electric power. Electropneumatic control and electric automatic two and three-term controls used in the pH control of the effluent are then considered. Selection and application of reagents in the pH control of the trade effluents are discussed briefly. Mention is also made of Redox controller which is used to control the oxidation-reduction reactions. (Shankar-Texas)
W70-05856

THE PROBLEMS OF INDUSTRY IN TRADE WASTE TREATMENT,
Effluent Control Ltd., Birmingham (England).
G. Mattock.
Water Pollution Control, Vol 67, No 3, 1968. p 295-310, 6 fig, 2 tab, 8 ref.

Descriptors: *Waste treatment, *Mechanical control, Oil, Settlement, Ion exchange, Maintenance, Industrial waste, Sludge disposal.
Identifiers: *Biodegradable effluent, *Discharge limits, Cyanide destruction, Chromate reduction, Toxic metal, Reagent, Capital expenditure.

Industries' problems related to treatment of effluent standards are reviewed. The aim is to achieve a desired effluent quality at a minimum cost. More attention is given to the inorganic effluents, because for these, generalized methods of treatment could be adopted more readily than for organic effluents. Cyanide destruction and chromate reduction are important stages in the effluent treatment. The local authorities have the responsibility to fix the standards of the effluents. Some standards suggested are unrealistic. Conditions like low cyanide level and low excess chlorine level in the effluent are difficult to meet without using expensive equipments. pH adjustments and precipitation of toxic metal-hydroxides also give rise to many problems. Discharge limits quoted regarding the suspended solids are not very distinct. There is also distressing vagueness in the definition regarding the discharge of oil. The paper further describes in general terms some of the approaches which could be undertaken towards water conservation. Recirculation has not received favorable mention except for ion-exchange. Cost of treatment is also considered in every stage in terms of both capital outlay and operating expenditure. (Shankar-Texas)
W70-05857

ADVERSE EFFECTS OF SYNTHETIC DETERGENTS ON SLUDGE DIGESTION IN JOHANNESBURG,
Johannesburg Sewage Treatment Works (South Africa).
D. W. Osborn.
Water Pollution Control Vol 68, No 6, p 664-668, Nov-Dec 1969 2 fig, 3 tab.

Descriptors: *Anaerobic digestion, *Detergents, *Sewage treatment facilities, Neutralization.
Identifiers: *Johannesburg (South Africa), *Stearine amine, Chlorinated hydrocarbons, Thermophilic digestion.

During the last five years a decline in gas production from the anaerobic digesters has been noticed at one of the three sewage-treatment plants in Johannesburg. The concentration of synthetic detergents has shown a considerable increase over the last six years. The Johannesburg plants are operating with concentrations of synthetic detergents in the raw sludge of 1.1 to 1.2 percent of dry solids. Any further increases in detergent concentrations above this critical range must be carefully watched. The only proven method of overcoming detergent inhibition of digestion is the addition of stearine amine (octadecylamine). About 15 tons of stearine amine acetate would have to be added to the digesters in order to partially neutralize the detergent already stored in them. An additional cost of about 0.94 cent per 1000 gallons would be required for this treatment. The increased use of chlorinated hydrocarbons, which are extremely toxic to the digestion process, warrants their monitoring at sewage treatment plants. Thermophilic digestions which was used in one digester did not seem to enhance the degradation of synthetic detergents. (Galwardi-Texas)
W70-05858

A SURVEY OF THE PERFORMANCE OF SEWAGE SLUDGE DIGESTERS IN GREAT BRITAIN,
Water Pollution Research Lab., Stevenage (England).
J. D. Swanwick, D. G. Shurben, and S. Jackson.
Water Pollution Control, Vol 68, No 6, p 639-647, Nov-Dec, 1969. 13 tab, 4 ref.

Descriptors: *Anaerobic digestion, *Sewage treatment, *Performance, Facilities, Retention, Operation, Design, Temperature, Detergents, Industrial wastes.
Identifiers: *Unheated, *Mesophilic, Overloading, Anionic detergents, Great Britain.

During the last four years the Water Pollution Research Laboratory has been asked to investigate an increasing number of difficulties with anaerobic sludge digestion. A survey has made it possible to access the total population served by the anaerobic process. This report is a first assessment of the information obtained from 1400 questionaires which were circulated to all local authorities and main drainage authorities. Heated and unheated digesters were treated separately and all plants have been classified according to digester performance. Returns were received from 142 plants with heated digesters, serving populations amounting to a total of over 18 million people. The causes of 92 cases of difficulty at 63 sewage plants were classified as: trade wastes 37.2 percent, inadequate design or operation 56.2 percent, and anionic detergents 6.5 percent. The chief cause of difficulties attributed to inadequate design or operation resulted from stratification and loss of solids from the digestion tank. Overloading was also reported as the main cause for difficulties at a number of treatment plants. Loading rates of primary digesters were analyzed and tabulated. However, no correlation between loading and digester performance was found. Retention times, frequency of feeding and temperatures in primary mesophilic digesters were tabulated. Secondary digesters were analyzed for storage capacity and dewatering actually achieved. Returns were received from 104 plants with unheated digesters, serving populations amounting to a total of 1.7 million people. Twenty-four works reported difficulties caused mainly by overloading and low winter temperatures. Due to the frequency of short retention periods reported, a detailed analysis was made of this parameter and the results from 83 works were tabulated. Also, it was noted that the absence of laboratory control was more prevalent at smaller works. (Galwardi-Texas)
W70-05859

NITROGEN REMOVAL BY MODIFIED ACTIVATED SLUDGE PROCESS,
Texas Univ., Austin.
Srinivasula Balakrishnan, and W. Wesley Eckenfelder, Jr.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No SA2, p 501-512, April 1970. 14 fig, 1 tab, 10 ref.

Descriptors: *Sewage treatment, *Nitrogen, *Denitrification, *Nitrification, Activated sludge, Trickling filter, Nutrients.
Identifiers: *Contact stabilization-denitrification.

Among the means of removing nitrogen from sewage is nitrification followed by denitrification. Laboratory scale studies using synthetic substrate showed that a loading factor of 0.3 to 0.4 should not be exceeded to achieve good nitrification in activated sludge. At a MLSS of 2000 mg/l and aeration period of 8 hours complete nitrification of 70 mg/l of ammonia was observed. A 6-ft-deep laboratory-scale trickling filter achieved 72% and 52% nitrification of raw settled sewage for hydraulic loadings of 10 MGD/acre and 30 MGD/acre, respectively. Batch run studies on denitrification showed that sludge loaded with carbonaceous material is capable of bringing about higher rates of dentrification than sludge relying on endogenous respiration alone. These studies suggested a modified activated sludge process called 'contact-stabilization-denitrification.' Settled raw sewage is contacted with sludge and clarified. The clarified liquor is pumped to a trickling filter. The nitrified trickling filter effluent and activated sludge loaded with soluble and colloidal material are contacted with each other for stabilization of organic material and denitrification. Sedimentation of the denitrified liquor is provided. Overall nitrogen removals of 85% were observed in laboratory studies. (DiFilippo-Texas)
W70-05860

CALCIUM CHLORIDE IN PROCESSING OF WOOLEN YARN WORKS WASTES,
J. S. Franklin, E. Bowes, and J. F. Colville.
Chemical Trade Journal, Vol. 154, p 78-79, 1964.

Descriptors: *Centrifugation, *Calcium chloride, Waste water treatment, Filtration.

Identifiers: *Wool scouring, *Wool wastes, Screening (Filtration), Hydrocyclone, Wool grease, Fiber wastes, Wool.

The waste treatment plant installed by Patons and Baldwins Ltd. at Darlington has been operating for two years for recovery of grease by treatment with calcium chloride. The mixed waste waters are first screened to remove wool fibers and treated in a hydrocyclone to remove most of the suspended solids and then centrifuged to recover neutral wool grease before cracking with CaCl2 and filtration. The cost of the pre-coating material for the vacuum filters has been reduced by blending suitably graded wood flour with expanded perlite. Direct application of the CaCl2 to the filter bowls has been successful in preventing the slow after precipitation of calcium chloride which had been causing difficulties in the filters. (Rhodes and Livengood-North Carolina State Univ)
W70-05861

RECLAMATION OF BY-PRODUCTS IN WOOL SCOURING (IN FRENCH),
S. Neubart.
Industrie Textile, p 615-620, 1964.

Descriptors: *Floatation, *Calcium chloride, Centrifugation, Chemical treatment.
Identifiers: *Wool grease, *Wool scouring wastes, *Acidification, *Fiber wastes, Scouring waste.

The author describes the extraction of wool grease from scouring effluent by the methods of acidification, floatation, calcium chloride treatment, and centrifuging. The chemical treatment of the grease and its uses are discussed. There is a description of the traditional method of reclaiming potassium, and details of a method developed by the author are given. (Mattox and Livengood-North Carolina State Univ)
W70-05862

TREATMENT OF TEXTILE WASTE LIQUORS,
A. H. Little.
Journal of the Society of Dyers and Colourists, Vol. 83, No. 7, p 268-273, 1967.

Descriptors: *Waste treatment, *Cost analysis, Biological treatment, Surfactants, Water reuse, Test procedures.
Identifiers: *Waste liquors, *Effluent treatment, *Textile mill wastes, *Dyehouse wastes, Liquor purification, Suspended solids removal.

The character of textile waste liquors and methods that can be employed for their purifications are discussed. Although the examples are based largely on cotton processing, the methods are applicable generally. The need for mixing and balancing waste liquors is emphasized. Methods of biochemical treatment are described with some indication of the relative costs. The method usually used to remove suspended solids is described briefly, and the effects of oxidizing and reducing substances on the biochemical treatment are discussed. The ease of treatment of effluents containing surface-active agents depends on ..hether the agent is 'hard' or 'soft', i.e., whether the agent has a high or low BOD. If the waste is discharged to a sewer, the treatment costs depend on the size of the community in which the works is situated. The re-use of part of the effluent from textile processes and the analytical tests made on the effluent are discussed briefly. (Mattox and Livengood-North Carolina State Univ)
W70-05863

WASTE LIQUORS FROM THE MERCERIZATION OF COTTON FABRICS AND LIMITING OF WASTE WATER ALKALINITY (IN CZECH),
Jaromir Josek.
Summeries in English, German, and Russian. Vodni Hospodarstvi, Vol. 16, No. 7, p 288-291, 1966.

Descriptors: *Alkalinity, *Cost analysis, *Neutralization, Carbon dioxide.
Identifiers: *Waste liquors, *Mercerization wastes, Mercerization, Sulfuric acid, Hydrochloric acid, Ferric sulfate, Flue gases, Salt content.

In the mercerization process, the consumption of mercerization caustic depends mainly on the humidity of the fabric entering and leaving the mercerization machine. To reduce the caustic consumption, increased wringing by the machine and use of waste liquor for the dissolving of the fresh caustic are suggested. The economics of the neutralization of the waste liquor by H2SO4, HCl, FeSO4. 7H2O, and CO2 (flue gases) and the salt content of the neutralized waste water are discussed. (Mattox and Livengood-North Carolina State Univ)
W70-05865

WOOL PROCESSING AND STREAM POLLUTION,
For primary bibliographic entry see Field 05B.
W70-05866

ENERGY-INDUCED CHANGES IN AN AZO DYESTUFF WASTE,
A. I. Mytelka, and R. Manganelli.
Journal Water Pollution Control Federation, Vol. 40, No. 2, I, p 260-268, 1968, 20 ref.

Descriptors: *Waste treatment, *Gamma radiation, *Chemical oxygen demand, *Bio-chemical oxygen demand, Industrial wastes, Solid wastes.
Identifiers: *Biological oxidation, *Azo dyes, *Total organic carbon, Color reduction.

Sterilization of water and waste-water by means of radiation is based on energy induced changes in the waste and the effect of these changes on subsequent biological oxidation. The industrial waste selected for testing was an azo dyestuff mother liquor with low biodegradability and intense color. The ionizing radiation source was cobalt-60 gamma rays. Parameters investigated include total organic carbon (TOC), COD, BOD, dye concentration, color, solids, and pH. Results show a decrease in the above variables, and a waste more amenable to biological oxidation as radiation dosage increased. (Mattox and Livengood-North Carolina StateUniversity)
W70-05867

CLARIFICATION OF TEXTILE WASTES BY MEANS OF MAGNESIUM CHLORIDE (IN CZECH),
J. Nosek, and J. Krepelka.
Vodni Hospodarstvi, Vol. 9, p 556-557, 1959.

Descriptors: Alkalinity, Magnesium Hydroxide.
Identifiers: *Textile mill wastes, *Magnesium chloride, *Dyes, *Clarification agents.

Full-scale tests of clarification of textile mill wastes by means of MgCl2 showed that, in a highly alkaline medium, it is a very effective clarification agent. The use of MgCl2 is especially advisable for laboratory tests, as the color of the originally white Mg (OH)2 may be a good indicator of the quantity of dye removed. (Mattox and Livengood-North Carolina State University)
W70-05868

TREATMENT OF WASTE WATERS FROM THE TEXTILE FINISHING INDUSTRY,
N. Merkel.
Melliand Textilber, Vol. 36, p 293-294, 1955.

Descriptors: *Sedimentation, *Flocculation, *Biological treatment, *Waste water treatment, Waste treatment, Iron compounds, Sludge.
Identifiers: *Finishing wastes, *Ferrous sulfate, *Color reduction, *Dyehouse Wastes, Waste waters integration, Water softening sludge, Textile mill wastes, Dyes.

About 2/3 of the waste waters produced in a textile finishing factory are relatively unpolluted and are kept separate from the polluted waters. Heavily polluted waters are mixed in sedimentation tanks holding about 3-5 hours output. By the mixing of different types of waste waters flocculation is encouraged and is completed by addition of FeSO4, other iron solution, or sludge from water softening. Final biological treatment usually takes place in sewage works. Sufficient dilution for reduction of color is important. (Mattox and Livengood-North CarolinaState University)
W70-05869

CLARIFICATION OF TEXTILE WASTE WATERS THROUGH THE USE OF WET TRANSFER OF SLAG AND ASH FROM STEAM BOILERS (IN CZECH),
J. Nosek.
Vodni Hospodarstvi, Vol. 11, No. 8, p 358-359, 1961.

Descriptors: *Waste water treatment, *Calcium hydroxide, Boilers, Analysis.
Identifiers: *Textile mill wastes, *Wet transfer, *Ferrous sulphate.

The quality of textile waste water, clarified by wet transfer, is approximately 40% as compared with the clarification of almost 50% obtained with ferrous sulfate and calcium hydroxide. (Mattox and Livengood-North Carolina State University)
W70-05870

WATER FOR THE DYER,
For primary bibliographic entry see Field 6D.
W70-05871

DIALYSIS OF CAUSTIC TEXTILE WASTES,
N. L. Nemerow, and W. R. Steele.
10th Industrial Waste Conference, Purdue University Engineering Extension Service, No. 89, p 74-81, 1955.

Descriptors: *Dialysis, *Waste water treatment, *Alkalinity, Waste waters, Filtration.
Identifiers: *Caustic, *Sodium hydroxide, Mercerizing wastes, Kiering wastes, Dyeing wastes, Hemicellulose, Pectins, Waxes, Dyes, Vacuum evaporators, Textile mill wastes.

In processing of cotton goods the waste waters from the mercerizing, kiering, and vat dyeing of the cotton are all strongly alkaline, with high BOD and excessive mineral content, and are colored. Dialysis of the waste waters to separate pure NaOH from the impurities such as hemicelluloses, pectins, waxes, and dyes, has been successful. The Solvay-Brosites dialyser has been developed to treat textile waste waters after concentration to about 38-40 percent caustic soda in vacuum evaporators, cooling, and filtration. (Mattox and Livengood-North Carolina State University)
W70-05872

COMBINED TREATMENT OF COTTON MILL AND DAIRY WASTES WITH SEWAGE,
A. Petru.
Water Waste Treatment, Vol. 11, No. 12, p 532-533, 1968.

Descriptors: *Waste water treatment, *Biochemical oxygen demand, *Chemical oxygen Demand, *pH, Sewage, Test procedures, Two-stage activated sludge plant, Sulphur, Copper sulphate.
Identifiers: *Cotton mill wastes, *Diary wastes, *Combined treatment, Textile mill wastes, Dichromates, Permanganates, Shock loading, Potassium chromate.

The combined treatment of cotton mill and dairy wastes with sewage was evaluated by treating synthetic sewage made from dried milk and textile wastes from an operating cotton mill. The wastes were tested manometrically. These manometric tests were followed by tests in a laboratory model, two-stage activated sludge plant. The combined

waste could be effectively treated (parameter, initial value, and percent reduction in primary and secondary stage, respectively): BOD 330 mg/l, 70, 94; Chemical Oxygen Demand (dichromate) 606 mg./l., 60, 77; Chemical Oxygen Demand (permanganate) 178 mg./l, 75, 84. Initial pH was 8.8-9.6. Shock loading to alkaline pH was adequately handled. S (2-) [17], Cr 1.68 (as K2Cr2O4), and Cu (as CuSO4) 41 mg./l. were without effect. Retention times of one hour in the primary and three hours in the secondary stage yielded acceptable results. (Mattox and Livengood-North Carolina State University)
W70-05874

TREATMENT OF WASTE WATERS FROM THE WOOL INDUSTRY (IN RUSSIAN),
M. N. Osherelyava.
Vodosnabzhenie i Sanitarnaya Tekhnika, No. 12, p 14-15, 1959.

Descriptors: *Waste water treatment, Lime, Biochemical oxygen demand.
Identifiers: *Wool scouring wastes, *Ferric chloride, *Clarity, Ferrous sulphate, Suspended wastes.

The composition and treatment of wool washing waste waters are discussed. Treatment with lime and ferrous sulfate is insufficient. Experiments with ferric chloride showed that this treatment increased clarity, reduced suspended matter from 3043 mg. to 435 mg/l and reduced BOD by 50%. Addition of lime was necessary only if the pH value required adjustment before discharge to a stream. (Mattox and Livengood-North Carolina State University)
W70-05875

USE OF UNICELLULAR ALGAE FOR PURIFYING WASTE WATERS FROM SYNTHETIC FIBRE UNDERTAKINGS (IN RUSSIAN),
G. M. Palamar-Mordvintseva, V. V. Grabovskaya, V. K. Marinich, and S. M. Naigauz.
Khimicheskie Volokna, No. 3, p 61-62, 1966.

Descriptors: *Waste water treatment, *Chlorella, Experiments, Waste waters, Ureas, Iron, Hydrogen sulphides, Sulphides, Biochemical oxygen demand, Calcium sulphates.
Identifiers: *Unicellular algae, *Man-made fiber plant wastes, *Effluent treatment, *Ankistrodesmus, *Food salts, Nylon-6, Magnesium sulphate, Potassium phosphate, Viscose rayon, Zinc, Carbon disulphide, Free oxygen.

Experimental work was done in the laboratory and in the open air at effluent-treatment plants of factories producing nylon-6 and viscose rayon on the use of unicellular algae (Chlorella and Ankistrodesmus). The growth of the algae in the waste waters can be stimulated by the addition of 'food' salts (urea, magnesium sulphate, and potassium phosphate). Removal of zinc, iron, hydrogen sulphide, carbond disulphide, and sulphides is 100%, the quantity of free oxygen is increased by 100-400% and the B.O.D. is reduced by 90%; only the calcium and the sulphates remain unaffected. Complete purification is achieved on the sixth day under laboratory conditions and on the third day in the open air. The work is regarded only as preliminary; no account of economic aspects has been taken. Further projected work on the possibility of cheapening the process by using by-products of the food and distilling industries is mentioned. (Mattox and Livengood-North Carolina State University)
W70-05876

CLARIFICATION OF SEWAGE FROM SYNTHETIC FIBER FACTORIES WITH THE AID OF SINGLE - CELL ALGAE (IN UKRAINIAN),
G. M. Palamar-Mordvintseva, V. K. Marinich, V. V. Grabovs'ka, and S. M. Neigauz.
Ukrains'kii Botanicheskii Zhurnal, Vol. 23, No. 5, p 56-61, 1966.

Descriptors: *Sewage treatment, *Chlorella, Hydrogen sulfide, Sulfur, Sulfides, Biochemical oxygen demand.
Identifiers: *Sewage clarification, Man-made fiber plant wastes, Experiments, Zinc, Carbon disulfide, Viscose rayon.

Experiments were conducted in open basins to confirm data obtained under laboratory conditions on the possibility of cultivating Chlorella algae on sewage from synthetic fiber production for the purpose of clarifying the sewage. Growth and development of algae and clarification of sewage were more rapid under natural conditions than in the lab. The main clarification was completed in 1 day in the presence of algae. A 3-day cultivation of the algae removed Zn, H2S, S, and sulfides (100%) and CS2 (60%) and decreased BOD by 92.5%. (Mattox-Livengood-North Carolina State University)
W70-05877

INJECTION OF RECLAIMED WASTEWATER INTO CONFINED AQUIFERS,
Toups Engineering, Inc., Santa Ana, Calif.; and Orange County Water District, Santa Ana, Calif.
G. M. Wesner, and D. C. Baier.
Journal American Water Works Association, Vol 62, No 3, p 203-210, March 1970. 8 p, 6 fig, 7 tab, 19 ref.

Descriptors: *Reclaimed water, *Injection wells, *Artificial recharge, *Saline water intrusion, *California, Water reuse, Odor, Taste, Water quality, Water pollution control, Monitoring, On-site tests, Aquifers, Groundwater movement.
Identifiers: Saline water barrier wells, Orange County (Calif).

The Orange County Water District, California has conducted research in wastewater reclamation and subsurface injection since July, 1965. The first phase of the work was intended to determine the feasibility of treating and injecting secondary effluent. The second phase has the following objectives: (1) Determine the hydraulic characteristics of the proposed injection barrier system of multipoint injection wells; (2) determine the long-term fate of reclaimed wastewater in the injection system; (3) determine the feasibility of utilizing wastewater for a barrier; and (4) determine the chemical composition of blended reclaimed water and deep groundwater. The multiple casing injection wells have performed very satisfactorily. The treated trickling filter effluent is injectable and would not cause excessive well clogging. Coliform bacteria have appeared sporadically 100 ft from the injection well, and have not been found at 245 ft. Many chemical constituents do not move conservatively in the injected water. Hardness and alkalinity increase; ammonia and other oxygen-demanding materials are significantly reduced by travel in the confined aquifer. The odor and taste which persist in the injected reclaimed water is probably the most serious deterrent to utilizing this source for injection in a barrier system. (Knapp-USGS)
W70-05880

5E. Ultimate Disposal of Wastes

SOLIDIFICATION OF SLUDGES WITH PORTLAND CEMENT,
Clarkson Coll. of Technology, Potsdam, N.Y.
For primary bibliographic entry see Field 05D.
W70-05832

5F. Water Treatment and Quality Alteration

THE EFFECTS OF ELECTROLYTE POWER ON IODINE-TREATED WATER,
Naval Medical Field Research Lab., Camp Lejeune, N.C.
Ned S. Hurst.
Available from the Clearinghouse as AD-699 179, $3.00 in paper copy, $0.65 in microfiche. Interim rept., Vol 19, No. 19, Dec 69, 12 p.

Descriptors: *Electrolytes, Halogens, *Water purification, Potable water, Halogenated pesticides, Pesticides, *Water treatment, Times, Lemons.
Identifiers: *Iodine.

The influence of an electrolyte powder on iodine-treated water was investigated. When 77 gm of the electrolyte powder were placed in iodine-treated water, 12.69 mg/liter, essentially all of the free iodine was removed in 60 minutes. The effect of electrolyte powder on the germicidal action of iodine was also investigated. The results were ambiguous and further research is indicated. The powder was a mixture of sucrose, citric acid, lime flavoring, sodium chloride, calcium chloride, and potassium monophosphate.
W70-05630

WASTE WATER RECLAMATION PROJECT FOR ANTELOPE VALLEY AREA,
Los Angeles Dept. of County Engineer, Calif.
For primary bibliographic entry see Field 05D.
W70-05645

MICROBIOLOGICAL ANALYSIS OF WATER.
Millipore Corp., Bedford, Mass.
For primary bibliographic entry see Field 05A.
W70-05722

ARSENIC IN DETERGENTS: POSSIBLE DANGER AND POLLUTION HAZARD,
Kansas State Geological Survey, Lawrence; and Kansas Univ., Lawrence. Dept. of Civil Engineering.
E. E. Angino, L. M. Magnuson, T. C. Waugh, O. K. Galle, and J. Bredfeldt.
Science, Vol 168, No 3939, p 389-390, April 17, 1970. 2 p, 3 tab, 8 ref.

Descriptors: *Detergents, *Arsenic compounds, *Waste water (Pollution), Kansas, Water softening, Enzymes, Public health, Standards, Potable water, Water reuse, Water treatment, Poisons.
Identifiers: *Household detergents, Kansas River.

Arsenic in amounts of 10 to 70 parts per million was found in several common presoaks and household detergents, using the sensitive silver-diethyldithiocarbamate method. To learn whether arsenic from waste waters of detergent products was adding to pollution of the Kansas River, samples were analyzed of detergents, water from the river, and water entering and leaving both the water and sewage treatment plants in Lawrence, Kansas. Arsenic values of 2 to 8 parts per billion were measured in the river. The concentrations approach the amount of 10 parts per billion, a drinking-water standard recommended by the U. S. Public Health Service. (Lang-USGS)
W70-05894

5G. Water Quality Control

IMPOUNDMENT WATER QUALITY CHANGES CAUSED BY MIXING,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Basic and Applied Science Program.
James M. Symons, William H. Irwin, and Gordon G. Robeck.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 93, SA 2, No 5205, p 1-20, 1967. 12 fig, 1 tab, 19 ref.

Descriptors: *Eutrophication, *Pumping, *Mixing, *Thermal stratification, *Water quality, On-site data collections, Kentucky, Impoundments, Oxygenation, Water quality control.
Identifiers: Destratification, Bullock Pen Lake (Ky), Boltz Lake (Ky).

Mechanical pumping was used to artificially destratify a 2,380-acre-foot lake (Boltz Lake) in northern Kentucky. Analysis of samples taken weekly, from May to October 1965, throughout the depth of the lake, showed the influence of mixing on water quality. A nearby lake of nearly equal volume (Bullock Pen Lake), sampled similarly, was used as a control. Results showed a warming and oxygenating of the lower layers of the test lake that resulted in the precipitation of manganese and the oxidation of sulfide. Mixing neither increased the concentration of any nitrogen form, or the total hydrolyzable phosphorus, nor decreased the clarity in the surface. There was no increase in algal densities. Data on work requirements and efficiences are also given. (Auen-Wisconsin)
W70-05558

MANAGEMENT AND MEASUREMENT OF DO IN IMPOUNDMENTS,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Applied Science Program.
James M. Symons, William H. Irwin, Robert M. Clark, and Gordon G. Robeck.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 93, SA 6, No 5688, p 181-209, 1967. 12 fig, 5 tab, 52 ref, appendix.

Descriptors: *Dissolved oxygen, *Stratification, *Hydraulic equipment, *Water quality, Temperature, Impoundments, Mathematical models, Kentucky, Mixing, Time, Pumping, Reservoirs, Profiles, Thermal stratification.
Identifiers: Artifical destratification, Air-Aqua system, Compressed air, Aero-Hydraulics Gun.

A basis for the comparison of various mechanical devices used for artificially destratifying impoundments by calculating their hydraulic performance based on impoundments stability is given. Three problems are discussed for clarification: influence of size and geometry on stability, natural changes in stability with time, and the basic hydraulic inefficiency of spring mixing if cold water is raised. A mathematical model is developed for studying the dissolved oxygen budget in impoundments with a solution presented, using specially designed dissolved oxygen determination equipment. Finally, data are presented on the destratification of a 2,930-acre-foot impoundment in northern Kentucky by pumping. The hydraulic performance of the pump is calculated and the influence of mixing on the reduced substances and dissolved oxygen resources in the impoundment shown. The most favorable period for destratification is discussed. (Auen-Wisconsin)
W70-05559

IMPOUNDMENT DESTRATIFICATION BY MECHANICAL PUMPING,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Applied Sciences Program.
William H. Irwin, James M. Symons, and Gordon G. Robeck.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 92, SA 6, No 5032, p 21-40, 1966. 14 fig, 2 tab, 23 ref.

Descriptors: *Eutrophication, *Thermal stratification, *Water quality control, *Mixing, Impoundments, Ohio, Lake morphometry, On-site data collections, Water temperature, Water properties, Pumping, Profiles.
Identifiers: Dissolved gases, Impoundment overturns, Destratification.

Mechanical pumping was used to eliminate thermal stratification in four lakes in southern Ohio during the summer of 1964. The lake volumes were 98, 100, 120, and 1260 acre-feet. Each impoundment was thermally and chemically stratified before pumping began. The equipment was a pontoon-mounted, axial-flow pump, 13 acre-foot/day capacity, driven by a gasoline engine. The pump drew water from the bottom and discharged it at the surface. Profiles of temperature, pH, and concentrations of dissolved oxygen and carbon dioxide were taken before and after pumping. Data presented show that this method was effective in destratifying these lakes. In addition, the data show that water quality was improved by artificial destratification and that an entire impoundment could be mixed with the pump located at a single position. Some data are presented on total work requirements, but these were dependent on the efficiency of the mechanical equipment and the percentage of cold water in the impoundment before pumping. (Auen-Wisconsin)
W70-05560

RESIDUES OF TWO HERBICIDES IN WATER IN IRRIGATION CANALS,
Bureau of Reclamation, Denver, Colo. Div. of Research; and Wyoming Agricultural Experiment Station, Laramie.
P. A. Frank, R. H. Hodgson, and R. D. Comes.
Weeds, Vol 15, No 4, p 353-355, October 1967. 2 tab, 3 ref.

Descriptors: *2-6-dichlobenil, *Herbicides, *Pesticide residues, *Aquatic weed control, *Irrigation canals, Irrigation water, Water conveyance, Water pollution, Water pollution sources, Weed control, Soil contamination, Toxicity, Persistence, Wyoming.
Identifiers: *2,3,6-trichlorophenylacetic acid, *Fenac, Plots.

Soil in irrigation canals is often treated by herbicides in order to control aquatic weeds. Irrigation water may be contaminated by subsequently flowing over the soil. Research was undertaken to study the persistence of 2,3,6-trichlorophenylacetic acid (fenac) and 2,6-dichlorobenzonitrile (dichlobenil) in irrigation water which had flowed over treated soils. The first water to cross the treated plots showed concentrations of 8.82 and 8.63 ppm concentrations of fenac and dichlobenil, respectively. The majority of the residue was quickly removed from the plots, with safe levels reached after one hour of water flow. Rapid reduction of herbicide concentration in water was possible when water was passed over areas of untreated canal soil. When this condition exists, or when it is possible to waste early water flows safely, disposal of the residues of the two herbicides is feasible. (Carr-Arizona)
W70-05599

AN ENGINEERING ECOMONIC STUDY OF THE INDUSTRIAL GROWTH POTENTIAL OF THE UPPER PASSAIC RIVER BASIN,
Stevens Inst. of Tech., Hoboken, N.J.
For primary bibliographic entry see Field 6B.
W70-05643

POTABLE WATER AVAILABILITY ON LONG OCEANIC ISLANDS,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 02L.
W70-05646

WATER RESOURCES AND WATER POLLUTION IN THE ECOLOGY OF AN INDUSTRIALIZED COUNTRY,
Iowa Univ., Iowa City. Dept. of Microbiology.
J. R. Porter.
Biotechnology and Bioengineering Symposium, No 1, p 133-158, 1969. 9 fig, 3 tab, 24 ref.

Descriptors: *Water resources, *Water pollution control, *Water pollution sources, Water conservation, Sewage, Biochemical oxygen demand, Diseases, Reservoirs, Silting, Air pollution, Sedimentation, Water reuse, Water purification, Legislation, Silica, Carbon dioxide.
Identifiers: Hydrocarbons, N-oxides, Particulate matter.

This comprehensive report reviews the supply and demand for water in the USA, regional water resources, and current and projected uses of water. The conclusion is that drastic measures must soon be taken to conserve the available supply of water and to reduce the present level of pollution. The latter includes daily flows of sewage, detergents, fertilizers, acids, and pesticides. Fecal pollution adds an alarming variety of intestinal and other pathogenes affecting man and domestic animals. The deposition of eroded silt reduces annually the reservoir capacity of the US by 1.5 billion cubic yards. The recent threat is presented by discharges of radioactive substances from 18 nuclear power plants (about 80 in 1975). Thermal pollution, water renovation, watershed control, solid waste disposal, and air pollution are subjects of the report. (Wilde-Wisconsin)
W70-05665

TRACER AIDS INTERPRETATION OF PUMPING TEST,
Oak Ridge National Lab., Tenn.
Wallace De Laguna.
Water Resources Research, Vol 6, No 1, p 172-184, February 1970. 13 p, 8 fig, 2 tab, 7 ref.

Descriptors: *Groundwater movement, *Aquifers, *Pumping, *Withdrawal, *Water pollution control, Water levels, Water quality, Water level fluctuations, Transmissivity, Permeability, Alluvium, Water pollution treatment, Radioisotopes, Radioactive wastes, Hydrogeology, Nuclear power plants.
Identifiers: Pumping tests, Aquifer testing, Scavenging wells, Mol (Belgium).

The nuclear research center at Mol, Belgium, is underlain by clean quartz sand to a depth of about 30 meters. An accident at one of the nuclear facilities, which could contaminate the groundwater, would entail serious consequences. The upper Mol sand is somewhat coarser grained and therefore probably more permeable than the underlying Casterle sand. The lower part of the Mol sand contains a number of thin clay layers which make a partial hydrologic barrier between the two formations, dividing the water table aquifer into two parts. A test well was installed, screened through the full thickness of both sands, and test pumped. Drawdowns were measured in observation wells screened both in the Mol sand and in the Casterle sand. A tracer was added to four of the observation wells in turn, and the arrival of the tracer was measured in the pumped well. The average travel times in the Mol and Casterle sand were used to determine the amount of water being produced from each by the pumping, and these data, with the observed drawdowns, were used to calculate the transmissibility, the permeability, and the storage coefficient of each of the two formations. The designs of several well systems for pumping contaminated groundwater out of the aquifers are discussed. Pumping out the contaminated groundwater and decontaminating it appears to be a practical method of resolving some of the problems that would be raised by a nuclear accident in the Mol area. (Knapp-USGS)
W70-05678

A METHODOLOGY FOR SELECTING AMONG WATER QUALITY ALTERNATIVES,
Florida Univ., Gainesville. Dept. of Environmental Engineering; and North Carolina Univ., Chaper Hill. Dept. of City and Regional Planning.
Gilbert S. Nicolson, Edwin E. Pyatt, and David H. Moreau.
Water Resources Bulletin, Vol 6, No 1, p 23-33, January-February 1970. 11 p, 7 fig, 1 tab, 16 ref.

Descriptors: *Water quality, *Reservoir operation, Water temperature, Thermal stratification, Eutrophication, Waste treatment, Optimization, Systems analysis, Decision making, Dissolved oxygen, Low flow augmentation, Water quality control, Dynamic programming.
Identifiers: Savannah River (Ga).

While reservoirs are constructed to regulate stream flows for several beneficial purposes including flood control, water supply, hydroelectric power, irrigation and low flow augmentation and to enhance water based recreation, they also create problems of water quality. Among other potential deleterious effects, thermal stratification in reservoirs inhibits mixing and causes a deterioration of dissolved oxygen levels in lower layers. Schemes for alleviating detrimental effects are reviewed and a methodology for evaluating some of these alternatives in a river-reservoir system is outlined. (Knapp-USGS)
W70-05703

ECONOMIC CONSIDERATIONS RELATIVE TO WATER QUALITY,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
William Whipple, Jr.
Water Resources Bulletin, Vol 6, No 1, p 34-42, January-February 1970. 9 p, 30 ref.

Descriptors: *Water quality control, Economics, *Planning, Water quality, Recreation, Water pollution control, Systems analysis, Cost-benefit analysis.

Our national water quality control program is on a wholly empirical basis. Not only has there been no effort to determine the benefits of water quality control, the theoretical groundwork for optimization has not been developed. Three main national objectives for consideration are national economic efficiency, preserving and improving the national environment for man's use and development (conservation), and regional development. Although popular at present, the regional development objective is not particularly useful from an economic viewpoint. Efficiency objectives other than environmental can be evaluated but are apt to be minor. Other water quality benefits can be broken down appropriately into 4 main categories: (a) man's recreational environment; (b) man's home environment; (c) man's working environment; (d) intangibles related to scientific, historic, health and cultural values. In management of water quality, various technical relationships must be considered, particularly as to quantity of water needed for waste disposal, and relationship of this use to water supply withdrawals. Advanced waste treatment must be compared with other alternatives, not only of flow augmentation, but also technological process changes, distribution of effluents, and artificial river aeration. (Knapp-USGS)
W70-05708

ECOLOGICAL STUDY OF BOLINAS LAGOON, MARIN COUNTY, CALIFORNIA,
Resources and Ecology Projects, Mill Valley, Calif.
For primary bibliographic entry see Field 02L.
W70-05713

SYSTEM ANALYSIS AND ITS APPLICATION TO RIVER BASIN POLLUTION CONTROL MANAGEMENT,
Jadavpur Univ., Calcutta (India). Dept. of Civil Engineering.
N. Chaudhuri.
Institution of Engineers (India) Journal, Public Health Eng Div, Vol 49, No 10. p 118-124, June 1969. 8 fig, 2 tab, 5 ref, 1 append.

Descriptors: *Systems analysis, *Linear programming, *River basins, *Water pollution control, Wastewater treatment, Optimization, Mathematical models, Cost, Water management (Applied).

The paper introduced the possibility of application of systems analysis as a tool for solving management problems of river pollution for an entire basin. The pollution control problem was shown as a linear programming model and the characteristics of its solution were illustrated graphically. A hypothetical river basin including locations of wastewater treatment plants was used as an example. The problem was to estimate an optimal combination of treatment efficiencies at two plants so that total cost of treatment was minimized and at the same time the minimum dissolved oxygen content was maintained in the river. For the numerical solution of the hypothetical river basin, the assumed value for various rate constants, distances, cost equation constants, plant discharges, BOD values of wastes coming to the plants, dissolved oxygen contents of effluent discharge and other values related to the river were given. (Kriss-Cornell)
W70-05769

MULTIPLE PURPOSE USE OF THERMAL CONDENSER DISCHARGES FROM LARGE NUCLEAR SYSTEMS TO SUPPLEMENT INTER-REGIONAL WATER SUPPLY,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 03D.
W70-05784

POLLUTION REDUCTION PROGRAM FOR THE TEXTILE INDUSTRY,
J. W. Masselli, and M. G. Burford.
Sewage and Industrial Wastes, Vol. 28, No. 10, p 1273-1293, 1956.

Descriptors: *Water pollution control, *Water pollution sources, Pollution abatement, Biochemical oxygen demand.
Identifiers: *Chemical substitution, *Process chemicals, *Textile mill wastes, Package treatment unit.

Report on New England Interstate Water Pollution Control Commission program on textile wastes to determine sources of pollution and possibility of using package treatment unit for them; considerable reduction in pollution may be obtained by substitution of low BOD for high BOD chemicals; process chemical inventory and BOD survey is aid in pin-pointing source of pollution. (Mattox and Livengood-North Carolina State Univ)
W70-05864

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

REGIONAL GROWTH AND INTERREGIONAL CAPITAL MOBILITY (IN GERMAN),
Institut fuer Internationale Wirtschaftsbeziehungen, Munich (West Germany).
Franz Holzheo.
Kyklos, Vol 22, Fasc 3, p 417-453, 1969. 5 fig.

Descriptors: *Regions, *Capital, Capital mobility, Prices, Labor supply, Demand, Competition.
Identifiers: *Capital movements, Wealth, Regional growth, Neoclassical model, Factor mobility.

This paper shows that endogenous treatment of international capital movements should be an essential element in the analysis of regional development. Capital movements to or from a region are assumed to depend on the real prices of interregionally traded goods and on the supply of labor, technical progress, the development of the demand for goods, and the accumulation of wealth in that region. In this view, interregional capital movements are a permanent phenomenon of regional growth and therefore should not be considered in the analysis of regional growth by treating them as exogenous disturbances. The author uses a neoclassical model based on neoclassical models of interregional trade to present his views. By introducing assumptions on competition and factor mobility which are different from those typically used in neoclassical analysis, the author modifies the results and brings them nearer to reality. As such, this would be of interest to the water researcher investigating the effects of interregional water transfers and investments. (Loeb-Rutgers)
W70-05574

EXPERIMENTAL DETERMINATION OF RELATIVE MARGINAL UTILITIES,
Harvard Univ., Cambridge, Mass.
Koichi Mera.
Quarterly Journal of Economics, Vol LXXXIII, No 3, pp 464-477, August 1969. 3 fig, 1 tab, 1 append.

Descriptors: *Marginal utility, *Welfare, Social function, Income, Benefits, Costs, Taxes.
Identifiers: *Social welfare function.

It is common knowledge that the social welfare function cannot be defined unambiguously. However, public officials need some social welfare function, implicit or explicit, in order to formulate and administer policies and programs. What is required is not an abstract social welfare function that is applicable to any situation, but a specific function that describes the preference of the public as represented by legislators. Such a welfare function can be derived from decisions made by a public body if several assumptions are granted. In this paper the author attempts to identify a set of assumptions needed for deriving a welfare function by taking the U.S. Congress as an example, without claiming that this particular set of assumptions is the only plausible one. This type of analysis would have relevance to the water area where water projects enter into the social welfare function. (Loeb-Rutgers)
W70-05579

ELECTRIC POWER AND ECONOMIC DEVELOPMENT,
National Economic Research Associates, Washington, D.C.
Bruce C. Netschert.
The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967. pp 1-23, 23 p, 22 ref.

Descriptors: *Electric power, *Hydro power, *TVA, *Economic evaluation, Growth rate, Costs, Government, Capital, Price, Industrial production, Multipurpose projects, Natural resource development, Social aspects, Value, Income, Cost minimization.
Identifiers: *Economic development, Discontinuities, Standard of living.

This article concerns the role played by energy sources generally and electric power in particular in programs of economic development. The argument is advanced and documented that large-scale power development is not a panacea. This was not so in the case of TVA, and it is perhaps less likely to be the situation for other areas. The largest problem in hydropower is the discontinuous nature of the cost curves, necessitating large initial capital investment, thus ruling out private investors. This is partially alleviated by multipurpose projects. The author concludes that a preoccupation with the development of thermal and hydro generating stations in the early stages of economic development is not an efficient allocation of capital. (Murphy-Rutgers)
W70-05581

NATURAL RESOURCE PROBLEMS AND TVA,
Resources for the Future, Inc., Washington, D.C.
Joseph L. Fisher.
The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967, pp 41-55, 15 p, 7 ref.

Descriptors: *TVA, *Natural resource development, *Economic analysis, Population, Demand, Cities, Dams, Income, Recreation, Electrical power, Costs, Nuclear power, Flood control, Water supply, River basins, Unemployment, Regional analysis, Planning.
Identifiers: *Urban growth, *Standard of living, Subsistence farming, Anti-poverty program.

The author discusses the TVA in the context of the changing problems of natural resource availability and utilization which face the United States. The discussion involves the contribution that TVA has made toward a solution to some of these resource problems. The author analyzes the national economy and predicts the consequences of the changing economic environment on the demand for natural resources. In general, a regional approach to the solution of these problems can supply major contributions. The author further suggests that it would be interesting to see the development of more regional agencies patterned after the broad multipurpose format of TVA. (Murphy-Rutgers)
W70-05583

MODELING OF THE GREAT LAKES WATER SYSTEM,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02H.
W70-05633

AN ENGINEERING ECOMONIC STUDY OF THE INDUSTRIAL GROWTH POTENTIAL OF THE UPPER PASSAIC RIVER BASIN,
Stevens Inst. of Tech., Hoboken, N.J.
For primary bibliographic entry see Field 6B.
W70-05643

THE TEMPORAL ALLOCATION OF GROUNDWATER - A SIMULATION APPROACH,
Geological Survey, Washington, D.C., and Resources for the Future, Inc., Washington, D.C.
John D. Bredehoeft, and Robert A. Young.
Water Resources Research, Vol 6, No 1, p 3-21, February 1970. 19 p, 17 fig, 32 ref.

Descriptors: *Water resources development, *Water allocation (Policy), *Water distribution (Applied), *Economics, *Groundwater basins, Groundwater, Groundwater movement, Planning, Withdrewal, Systems analysis, Water storage, Optimization, Forecasting, Mathematical models, Analog models, Simulation analysis, Water utilization.
Identifiers: Groundwater allocation.

Users of groundwater are typically interdependent in that withdrawals affect the conditions of water supply experienced by neighboring pumpers. In such cases all costs are not registered on the unit making the withdrawal decision, and the individual user of groundwater is encouraged to withdraw water at a rate faster than is socially optimal. Previous attempts to consider the problem of the optimal rate of pumping over time from a groundwater basin have used a simplified model for the groundwater system that assumes that drawdowns in response to withdrawals are uniformly distributed through the basin. However, large differences in drawdown commonly occur in developing groundwater systems. These differences throughout the basin lead to great variations in water costs and perhaps to localized economic and hydrologic failure. A more realistic groundwater model was used in a simulation program representing a groundwater basin system. The effects of two policy instruments (a use tax and a quota) were investigated for a hypothetical basin in an arid region in which irrigated farming was the principal economic activity. A policy of unrestricted use was compared with a policy of regulation for several alternative aquifer developments. Policies that reduced the rate of withdrawal increased the discounted net economic yield. (Knapp-USGS)
W70-05699

A TWO-STAGE OPTIMIZATION MODEL FOR DESIGN OF A MULTIPURPOSE RESERVOIR,
California Univ., Los Angeles; and Chile Univ., Santiago.
Fereidoun Mobasheri, and Ricardo C. Harboe.
Water Resources Research, Vol 6, No 1, p 22-31, February 1970. 10 p, 3 fig, 11 ref. OWRR Projects A-003-CAL and B-061-CAL.

Descriptors: *Reservoir design, *Multiple-purpose reservoirs, *Optimization, Systems analysis, Dynamic programming, Water resources development, Mathematical models, Synthetic hydrology, Computer programs.
Identifiers: Two-stage optimization models.

A mathematical model that can be useful in determining the optimum design and operation of a single multipurpose reservoir is presented. The development purposes include firm water supply, firm on-peak and dump hydropower production, flood control, and low flow augmentation. The model is based upon a two-stage optimization technique. It takes into account the fact that economic returns from a project are a function of both design and operational rules of the project. A dynamic programing algorithm which has a physical recursive equation computes the optimum operation policy of a feasible design. An iterative uniform grid sampling algorithm is then used to compare designs for which optimum operations are already determined and to select the best design. The model is applied to a hypothetical water resources project for illustrative purposes. The limitations of this mathematical model and some future research that may eliminate these limitations are discussed. (Knapp-USGS)
W70-05700

NONLINEAR PROGRAMING APPLIED TO REGIONAL WATER RESOURCE PLANNING,
Federal Water Pollution Control Administration, Washington, D.C.
George K. Young, and Mark A. Pisano.
Water Resources Research, Vol 6, No 1, p 32-42, February 1970. 11 p, 3 fig, 4 tab, 8 ref.

Descriptors: *Systems analysis, *Optimization, *Cost analysis, *Water resources development, *Decision making, Water supply, Desalination, Surface waters, Groundwater, Water reuse, Water demand, Forecasting, Water utilization.
Identifiers: *Sensitivity analysis, James River (Va), Nonlinear programming.

Methods of nonlinear programming are given for finding the least-cost mix of alternatives reservoirs, weather modification, wells, desalination, and treated waste water) to satisfy future water demands within a region. The analysis demonstrates that analytical techniques can be applied to the complex problem of water supply to make the planning process more meaningful. Decisions can be made with some degree of confidence that they will not be outdated before initiated. A sensitivity analysis is attempted in an effort to define the effect of future technology on the alternative sources of water, but because of the unpredictability of this factor, other approaches must be tried. (Knapp-USGS)
W70-05701

ROUTE OR CONVOLUTE,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02A.
W70-05702

A METHODOLOGY FOR SELECTING AMONG WATER QUALITY ALTERNATIVES,
Florida Univ., Gainesville. Dept. of Environmental Engineering; and North Carolina Univ., Chaper Hill. Dept. of City and Regional Planning.
For primary bibliographic entry see Field 05G.
W70-05703

SPECIFICATIONS FOR A COMPUTER SIMULATION MODEL OF THE NATIONAL WATER DATA SYSTEM, PHASE A, FINAL SUMMARY REPORT,
Travelers Research Corp., Hartford, Conn.
Robert H. Ellis.
January 1967. 138 p, 41 fig, 3 tab.

Descriptors: *Computer programs, *Simulation analysis, *Mathematical models, *Water data system, United States.
Identifiers: Output, Input, Processing levels.

The concept and specifications were developed for a computer simulation model to be used as an analytical tool to evaluate the operational efficiency of existing and hypothetical water data information systems. The work was part of a program to develop a water data acquisition processing and dissemination system which best meets the needs of the United States water data users both within and outside the government. A description of the water data information system of the Water Resources Division of the Geological Survey, Department of the Interior was given. The types of data observed, processed and disseminated by many government agencies, were described and characteristics of each data type in terms of numerical model descriptors were indicated. Output of the simulation model together with appropriate application of the output for evaluation of water data systems was described. The report specified simulation model input requirements, model components, machine requirements and model scope. The system shown had four processing levels and it was determined that aggregation of detail at the observation processing level would permit simulation of the entire system within the constraints dictated by computer storage capacity. It was further shown that where the storage requirements of the entire hierarchy of processing levels comprising a proposed information system exceed computer capacity, one or more levels may be simulated separately and the results combined to provide information relevant to the whole system. (Kriss-Cornell)
W70-05768

SYSTEM ANALYSIS AND ITS APPLICATION TO RIVER BASIN POLLUTION CONTROL MANAGEMENT,
Jadavpur Univ., Calcutta (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 05G.
W70-05769

SEVERAL DYNAMIC PROGRAMMING ALGORITHMS AND THEIR APPLICATION TO A DAM PROBLEM,
California Univ., Berkeley. Operations Research Center.
Marc H. Blanc.
NSF Grant GK-1684. ORC 69-40, Dec 1969. 28 p, 1 fig, 1 tab, 4 ref, 1 append.

Descriptors: *Dynamic programming, *Optimization, *Mathematical models, Hydro-electric plants, Variability.
Identifiers: Shasta Dam, Algorithm, Data arrays, Graphs.

A comparative study of three dynamic programming algorithms was made. These included: (1) Standard dynamic programming; (2) Incremental dynamic programming; and (3) Incremental dynamic programming with approximation. Optimization of the scheduling of complex hydro-electric systems was studied. First, the formulation in mathematical terms of the corresponding control problems and the description of the algorithms were given. Then the models were applied to the regulation of the Shasta Dam. The problem was solved by each of the three methods, including a cross testing of the procedure and several changes of parameters. The results were displayed in data arrays and by graphs. A variational method that combined features of a dynamic programming algorithm and a gradient procedure was introduced in the appendix. (Kriss-Cornell)
W70-05770

AN ALTERNATIVE PROCEDURE FOR THE OPTIMIZATION OF OPERATIONS FOR

PLANNING WITH MULTIPLE RIVER MULTIPLE PURPOSE SYSTEMS,
California Univ., Los Angeles.
Warren A. Hall, G. W. Tauxe, and W. W-G. Yeh.
Water Resources Research, Vol 5, No 6, p 1367-1372, Dec 1969. 3 ref.

Descriptors: *Optimization, *Planning, *Multiple purpose projects, *River systems, Dynamic programming, Linear programming, Constraints, Time.
Identifiers: Modified gradient procedure, Monte Carlo analysis.

A technique was developed for maximizing the financial feasibility of a complex, multiple river water resources system for planning purposes, based on deliveries of firm power, in-season water, dump power, and off-season water, with flood control and releases for non-commensurate objectives as parameters. The method was an important modification of a previously reported analysis developed by Parikh involving dynamic programming, linear programming, and modified gradient procedure, replacing the computationally inefficient linear programming determination of the shadow prices by a standard sequence of constraints. Total computation time was reduced from hours to minutes. (Kriss-Cornell)
W70-05776

SIMULATION OF STREAMFLOW IN SCOTLAND,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-05899

RISKS IN HYDROLOGIC DESIGN OF ENGINEERING PROJECTS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05905

6B. Evaluation Process

PLANNING TECHNIQUES FOR REGIONAL DEVELOPMENT POLICY,
Maryland Univ., College Park.
Curtis C. Harris, and Martin C. McGuire.
Journal of Human Resources Vol IV, No 4, p 466-490, Fall 1969. 25 p, 6 tab, 2 fig.

Descriptors: *Regional analysis, *Economic evaluation, *Population, *Forecasting, *Employment, *Unemployment, Migration, Growth rates, Welfare economics, Budgeting, Gross National Product, Capital, Model studies, Least-squares regression, Cities, Social mobility, Distribution patterns.
Identifiers: Sensitivity analysis, Time trends, Econometrics, Job creation.

One aspect in applied welfare studies concerns the interaction between the growth of national economies and the constituent subeconomies of which the national economies are comprised. At present, the fundamental issues for public policy consideration are the questions of what constitutes an appropriate regional distribution of economic activity. This paper seeks to develop techniques for the projection and analysis of the distribution of economic progress among the counties in the United States. The paper describes the alternative regional projections of employment and income; the alternative population projections for comparable regions; and the comparisons of labor force availabilities and demands for labor by region. The paper points to the importance of national migration policy in the future and the very high unemployment expected in urban centers by 1975. The importance of regional development and planning in determining water resource needs, projections and subsequent policy makes this article of interest to studies of regional water planning. (Murphy-Rutgers)
W70-05570

DYNAMIC PROGRAMING FOR THE OPTIMAL SEQUENCING OF WATER SUPPLY PROJECTS,
Nevada Bureau of Mines, Reno. Desert Research Inst.; California Univ., Los Angeles; and California Univ., Riverside.
William S. Butcher, Yacov Y. Haimes, and Warren A. Hall.
Water Resources Research, Vol 5, No 6, p 1196-1204, December 1969. 3 fig, 5 tab, 3 ref.

Descriptors: *Dynamic programming, Water supply, Costs, Investment, Demand, Interest rate, Time, Planning.
Identifiers: *Optimal sequencing, *Water supply projects, Water projects, Present cost.

This article derives minimum present cost strategy for investment in water projects. An increase in demand for water is considered to be supplied by a number of projects that have an indefinite life. The optimum sequence of installation of these projects is determined by (1) the shape of the water demand/time relationship, (2) the appropriate interest rate, and (3) the relative costs and capacities of the facilities from which a selection is made. A general method to derive the optimum sequence of construction is developed using dynamic programing. Examples of the use of the technique are given. (Loeb-Rutgers)
W70-05571

MARGINAL VALUES OF DILUTION WATERS,
Washington Univ., Seattle.
Lavere B. Merritt, and Brian W. Mar.
Water Resources Research, Vol 5, No 6, p 1186-1195, December 1969. 4 fig, 3 tab, 15 ref, 1 append.

Descriptors: *Water resources, Waste dilution, Economics, Waste water, Costs, Marginal costs, Waste treatment, Biochemical oxygen demand.
Identifiers: *Marginal value, *Dilution waters, Willamette River Basin.

For the allocation of a water resource to be based on economic criteria, the marginal values of water used for alternative purposes must be determined. In this paper, an order of magnitude estimate is presented of the marginal value of water used for dilution of treated or untreated waste waters. Such information should be of interest to an exporter of water in evaluating the increased cost of water quality control owing to receiving water flow reduction as well as to an importer of water who anticipates a reduction of water quality control costs (other than the cost of dilution water) owing to flow increase. It is assumed in this study that waste dilution and treatment are complementary methods of waste disposal to satisfy the constraint on waste loading defined by water quality standards or effluent charges. (Loeb-Rutgers)
W70-05572

WATER RECREATION, DEMAND, AND SUPPLY,
Rutgers - The State Univ., New Brunswick, N.J.
Joseph J. Seneca.
Water Resources Research, Vol 5, No 6, p 1179-1185, December 1969. 13 ref.

Descriptors: *Demand, *Supply, Water resources, Time series analysis, Cost-benefit analysis, Planning, Recreation, Statistical methods.
Identifiers: *Water recreation, Cross section data, Polling technique, Rates of use, National Recreation Survey, Tennessee Valley lakes.

This paper discusses the problems involved in identifying valid demand and supply parameters estimated from sample data on recreation. It is argued that an analysis of cross section data permits the quantification of the effects of demand variables. Cross section results can then be pooled with recreation time series to enable the valid estimation of supply parameters. These supply parameters can be used to improve decisions regarding the expansion and development of recreation sites. More refined projections of rates of use can be derived for use as benefit measures in cost-benefit analysis. An example of the pooling technique is presented using demand equations estimated from the National Recreation Surveys and a time series of visitation data at the Tennessee Valley lakes. The results tend to confirm the superiority of the method proposed, particularly in comparison with an analysis using only time series data. (Loeb-Rutgers)
W70-05573

STOCK-FLOW DECISIONS AND FULL EQUILIBRIUM,
Paris Univ. (France); and Cologne Univ. (West Germany).
Emil M. Claassen.
Kyklos, Vol 22, Fasc 3, p 493-504, 1969. 2 fig, 9 ref, 1 append.

Descriptors: *Flow, Planning, Decision making, Equilibrium.
Identifiers: *Savings, *Assets, *Stocks, Utility maximization, Planning horizon, Hicksian concepts.

The study is concerned with the optimum saving-assets position of an individual. This optimum position is the outcome of simultaneous utility maximization with respect both to intertemporal consumption flows and to stocks of more than one type of asset. The optimal conditions of these stock-flow-decisions are stated in the form of a model based on the assumptions that the individual has a multiperiod planning horizon, and that he is confronted with two types of assets. This stock-flow equilibrium is examined for: (1) a single period and (2) for a whole series of periods. Using the Hicksian concepts, revived by Archibald and Lipsey, the author speaks, in the first case, of weekly equilibrium, and in the second, of full equilibrium meaning that the individual reaches, after a series of weeks, the invariance over time of his desired stock of assets. This article may also be regarded as an attempt to fill the lacunae in the graphical presentation of Patinkin's 'Utility Theory of Money, Assets, and Savings' (Money, Interest, and Prices, 2nd ed). This article may prove applicable to the water researcher in the area of water investment and planning. (Loeb-Rutgers)
W70-05575

USER RESPONSE IN OUTDOOR RECREATION: A PRODUCTION ANALYSIS,
Rutgers - The State Univ., New Brunswick, N.J.; and Resources for the Future, Inc., Washington, D.C.
Joseph J. Seneca, and Charles J. Cicchetti.
Journal of Leisure Research, Vol 1, No 3, p 238-245, Summer 1969. 2 fig, 1 tab, 6 ref.

Descriptors: *Recreation, *Supply, *Recreation demand, Recreation facilities, Demand, Model studies, Forecasting, Statistical methods, Economic predictions, Swimming, Boating, Fishing, Land, Water supply.
Identifiers: *User response function, *Production analysis, Appalachian Region, Recreation use, Recreation visits, Identification problem, Econometrics, Economic model, Empirical estimation, User day projections, Land acres, Parking places, Water acres.

This study attempts to identify the influence of production-type variables on outdoor recreation activity. A large amount of previous recreation research has been concerned with estimating recreation 'demand.' In this paper, it is argued that there are inherent problems in estimating recreation 'demand' that often lead to erroneous policy conclusions. Part of this confusion is due to neglect in evaluating the influence on recreation activity of the supply or production side of the recreation market. Cross-section data of recreation sites in the Appalachian Region was used to estimate the rela-

tion between the extent of recreation use and various physical indices of the recreation site. The result is a user response function that establishes a quantitative relation between the physical facilities of the recreation site and the quantity of recreation visits occurring there. This relation can be used to simulate various recreation policy alternatives and obtain quantitative indications of the number of recreation visits that could be accommodated by the postulated supply of facilities without altering the quality of the recreation visits implicit in the user response function. An empirical example of projecting recreation user response to proposed facility increases in a subregion of the Appalachian area is presented. The close relation of water resources and water quality to outdoor recreation make this article relevant to the water study area. (Loeb-Rutgers)
W70-05576

BENEFIT-COST RATIOS FOR PROJECTS IN MULTIPLE OBJECTIVE INVESTMENT PROGRAMS,
Massachusetts Inst. of Tech., Cambridge.
David C. Major.
Water Resources Research, Vol 5, No 6, p 1174-1178, December 1969. 1 fig, 12 ref.

Descriptors: *Cost-benefit ratio, *Investment, Water resources, Income, Planning.
Identifiers: *Multiple objectives, Social preferences, Regional development.

Investment programming for multiple objectives has become an important new element of water resources planning in the United States. In addition to the traditional water resource planning objective of increasing the national income, explicit statements of planning objectives now include goals such as regional development and improvement of the quality of the environment. A question that naturally arises when projects in multiple objective programs are considered is the composition of the benefit-cost ratios appropriate to them. The question of developing appropriate benefit-cost ratios for multiple objective projects has been complicated for the water resource agencies because, as is shown in this paper, the current federal instructions for formulating such ratios do not permit the agencies to reflect the interaction of social preferences and investment opportunities in an accurate manner. The purposes of this paper are to demonstrate how the formula for the benefit-cost ratio of a multiple objective project is derived from the theory of multiple objective public investment; to indicate how this formula differs from the guidance offered in the current federal instructions; and to recommend that these instructions be broadened to permit the water resource agencies to use the appropriate formula for benefit-cost ratios of multiple objective projects. (Loeb-Rutgers)
W70-05577

COOPERATIVE CITY-COUNTY RATE STRUCTURES,
Baltimore County, Md.; and Burns and Roe, Inc., Oradell, N.J.
William A. Badger, and John L. Rose.
Journal of the American Water Works Association, Vol 61, No 11, p 581-584, November 1969. 2 fig, 3 tab, 5 ref.

Descriptors: *Cities, Consumptive use, Rates, Water supply, Population.
Identifiers: *County, *Rate structure, Baltimore, Fiscal responsibility.

One of the most pressing problems of urban affairs is the effect of the population exodus from the core city and the growing demands for governmental services in the suburban-metropolitan area. Little attention has been devoted to the impact of this phenomenon on the provision of adequate water supply. The author illustrates the problem using the Baltimore metropolitan region as an example. Since World War Two, Baltimore County has experienced a large population growth while the city of Baltimore has grown only slowly. The increase in population has been accompanied by a commensurate increase in water consumption. Initially, the city has acted as a surveyor of water to suburban areas and as a banker for financing improvements to the water system. The declining population trend, eroding tax base, and increasing level of expenditures required to maintain service in the suburbs has resulted in a change in the relationship between city and county. This paper discusses the challenge to finance facilities necessary to provide service through equitable allocation of costs while maintaining reasonable rate structures. (Loeb-Rutgers)
W70-05578

THE APPLICATION OF TVA EXPERIENCE TO UNDERDEVELOPED COUNTRIES,
Development and Resources Corp.
John Oliver.
In The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967, p 26-40, 14 p, 2 ref.

Descriptors: *TVA, *Economic analysis, Technology, Planning, Capital, Financing, Multipurpose projects, Dams, Management, Government, Population, Regional analysis, Irrigation, Electric power, Agriculture, Investment.
Identifiers: *Economic development, *Columbia, *Iran, International finance, Standard of living.

This paper evaluates the applicability of the TVA experience to the underdeveloped areas. The author argues that the uniqueness of TVA is the basic concept and philosophy of the program, not the details of its operating procedures or its approaches to the solution of specific or isolated problems. After pointing out the important philosophical and organizational attributes which a TVA counterpart in an underdeveloped area must have and the difficulties which might be encountered in establishing these prerequisites, the author gives two case studies showing problems and procedures involved in establishing development agencies modeled after TVA: the Cauca Valley Corporation in Columbia and the Khuzistan Water and Power Authority in Iran. The economics of the water projects are evaluated and their economic effects discussed. (Murphy-Rutgers)
W70-05582

IDENTICAL PRICING AND TVA: TOWARD MORE EFFECTIVE COMPETITION,
Tennessee Univ., Knoxville.
Ronald H. Wolf.
In The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967, p 81-104, 24 p.

Descriptors: *Competition, *TVA, *Prices, Economic analysis, Government, Electric power, Bids, Cost analysis, Contracts, Economic evaluation, Legal aspects, Benefits, Supply.
Identifiers: *Antitrust, *Identical bids, *Collusion, Price-fixing, F.O.B. pricing.

This paper looks at the recent role of TVA in promoting competition in the private sector of the economy. The author gives a detailed examination of activities of TVA in exposing the bid-rigging which involved many major producers of electrical equipment who were supposedly selling to the agency on a competitive-bid basis. The TVA has often received identical bid prices which may result from competition but more often from concerted action on the part of rivals to act together on price, or from discrimination in absorbing freight in the case of some customers in order to achieve equality. Benefits arising from the prosecution of the identical bidders are discussed. The author evaluates the weaknesses in contemporary antitrust policy and makes suggestions for improvement. Since government agencies, water utilities included, are possibly subject to the same collusive practices, this article should be of interest to the water researcher. (Murphy-Rutgers)
W70-05584

A NOTE ON THE EQUIVALENT RISK CLASS ASSUMPTION,
Minnesota Univ., Minneapolis.
Ronald F. Wippern.
The Engineering Economist Vol 11, No 3, p 13-22, Spring 1966. 10 p, 2 tab.

Descriptors: *Risks, *Statistics, *Profits, Capital, Costs, Financing, Economics, Growth rates, Financial analysis, Economic evaluation, Sampling, Probability.
Identifiers: *Statistical analysis, *Analysis of variance, Profit variability, Per share earnings.

The assumption that firms within the same industry are subject to equivalent degrees of basic uncertainty is widely employed in financial theory and underlies many of the approaches to valuation. The purpose of this paper is to examine the validity of the risk-equivalency assumption and subject this assumption to statistical analysis. A sample of eight industries was selected in order to achieve a high degree of heterogeneity among industry characteristics and sixty-one firms within the industries were included. The validity of the assumption was tested by an analysis of variances to determine whether the net operating income per share variability measures differ significantly among industry groups. It was found that the homogeneity of business uncertainty is not achieved by confining samples to single industries. Since risk is an important factor in many water resource investments this article should be of interest to individuals concerned with the cost of financing public water expenditures. (Murphy-Rutgers)
W70-05585

WHICH DOLLARS--WHOSE UTILITY FUNCTIONS,
Massachusetts Inst. of Tech., Cambridge.
George E. Klein.
The Engineering Economist, Vol 12, No 2, p 107-116, Winter 1967. 1 fig.

Descriptors: Income, Costs, Decision making, Risks, Time, Management.
Identifiers: *Utility function, Incremental analysis, Stability.

There are still some phases of utility theory that require further thought. The author identifies two of the remaining problems and offers some tentative suggestions for their solution. The main focus of attention will be on which dollars and whose utility to use. The author contends that we should consider only the distribution of the net result for a project. Each possible level of revenue less its related cost is the appropriate measure. All projects over all future time should be considered together and it is the incremental contribution of a project to the utility of this grand total that bears the appropriate information upon how to make decision. On this issue of whose utility function should be used for a large organization, the answer is less clear but it seems that no one utility function is suitable. A point of view has been developed which indicates it is management's responsibility to purposively choose a pseudo-utility function for the firm, taking a position which it can sell to the other members of the coalition. This article may prove helpful to the water resource planner involved with managerial decisions. (Loeb-Rutgers)
W70-05586

ENVIRONMENTAL QUALITY IN A GROWING ECONOMY,
Resources for the Future, Inc., Washington, D.C.
Henry Jarrett.
Baltimore, Maryland, Johns Hopkins Press, 1966, 173p.

Descriptors: *Pollution, *Economic analysis, *Natural resources, Welfare economics, Cost-benefit analysis, Resource allocation, Income, Conservation, Prices, Wells, Rivers, Flood control, Federal government, Marketing, Social aspects, Environmental effects, Wastes, Fisheries, Water pollution, Pesticides, City planning, Industrial production.

Identifiers: *Environmental management, *Economic development, Chemical pollution.

This book contains a selection of essays originally presented at the Sixth Resources for the Future Forum on March 8 and 9, 1966. In the first two essays an inquiry is made into how natural resource development has and will affect the environment. The second pair of essays deals with the effects of environment upon human health, both physical and mental. The problems and possibilities of the fact that many of the economic problems of environmental quality are caused or aggravated by conditions lying outside the market economy is examined. The fourth set of essays examines the current state of economic research into the problems of the environment. The formation and evaluation of the public attitude towards environmental development is examined. The tasks and effects of all levels of government is studied in the last set of essays. Although the article is concerned with all aspects of environmental conservation, this book provides valuable insights for the water resource planner interested in the general problems of environmental quality. (Murphy-Rutgers)
W70-05587

MULTIPURPOSE BENEFITS AND COSTS OF MODIFYING PLAYA LAKES OF THE TEXAS HIGH PLAINS,
Texas Technological Coll., Lubbock. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 03B.
W70-05589

EMPIRICAL ANALYSIS OF THE DEMAND FOR WATER BY ISRAELI AGRICULTURE,
Hebrew Univ., Jerusalem (Israel).
Dan Yaron.
Journal of Farm Economics Vol 49, No 1, Part 1, p 461-473, February 1967. 2 fig, 1 tab, 20 ref.

Descriptors: *Water demand, *Economics, *Water resources, *Water allocation (Policy), *Model studies, Regional analysis, Resource allocation, Irrigation water, Irrigation, Agriculture, Economic impact, Equations, Farms, Crop production, Analytical techniques, Political aspects, Social impact.
Identifiers: *Israel, *Empirical analysis, *Demand function for water, Factors of production.

The paper presents an approach used to analyze water demand in Israeli agriculture. The heart of the analysis was a country-wide aggregative programing model which was used to derive the marginal segment of the demand function for water. This was used as a basis for evaluating overall demand function. It was a central thesis of the approach that in analyzing complex problems of agricultural water resources irrigation water should be treated as just another production factor in the agricultural production process. Results of the study indicate that the shape of the demand function for water depends to a great degree on the sociopolitical economic mix. This mix determines the framework within which the demand function is derived. Water allocation efficiency has a particularly strong influence on the demand function. Thus the more realistic the agricultural development program data used to derive the agricultural demand function for water, the more realistic the estimate of the function will be. (Carr-Arizona)
W70-05600

A STUDY OF INSTITUTIONAL FACTORS AFFECTING WATER RESOURCE DEVELOPMENT IN THE LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
Thomas J. Casbeer, and Warren L. Trock.
Available from the Clearinghouse as PB-191 063, $3.00 in paper copy, $0.65 in microfiche. Technical Report No 21, Water Resources Institute, Texas A and M University, September, 1969. 160 p, 6 tab, 84 ref, 3 append. OWRR Project B-025-TEX.

Descriptors: *Institutions, *Efficient resource use, *Water rights, *Irrigation, Drainage, Special districts, Rehabilitation, *Water resources development, Texas.
Identifiers: Rio Grande Valley.

Among the institutional factors which complicate water development and use in the Valley are: (1) a proliferation of special districts, (2) inappropriate water management policies among districts, (3) uncertainties in water rights, and (4) numerous governmental entities involved in planning for and administration of water resources. In the Valley, these factors have acted as deterrents to many needed developments and to changes in uses which would be economic. It is recommended that the people of the Valley request an early adjudication of rights. Certainty in the water rights will contribute to decisions to invest in the resource. Negotiability of rights is also suggested. This would require a change in State law, but it would facilitate achievement of efficiency in use of water in the Valley. Rehabilitation of irrigation systems, including installation of water meters is a needed further development. To achieve improvements in irrigation, flood control and drainage, some reorganization of people in special districts will probably be necessary. A master district for the three-county area may be a logical alternative to the many that now exist.
W70-05641

AN ENGINEERING ECOMONIC STUDY OF THE INDUSTRIAL GROWTH POTENTIAL OF THE UPPER PASSAIC RIVER BASIN,
Stevens Inst. of Tech., Hoboken, N.J.
Arthur Lesser, Jr., A. H. Spinner, and M. A. Tirabassi.
Available from the Clearinghouse as PB-191 065, $3.00 in paper copy, $0.65 in microfiche. Economics of Engineering and Management Science Dept., Stevens Institute of Technology. OWRR Projects B-009-NJ and B-017-NJ.

Descriptors: *Systems analysis, *Water quality, *Water pollution control, Simulation analysis, Industries, Industrial wastes.
Identifiers: Water quality parameters, Industrial growth potential, Industrial growth patterns.

The report covers research as to water quality and industrial growth on the upper Passaic River. Data over a period of years were obtained, including both parameters of water quality and profiles of industrial waste characteristics. Data were related by statistical analysis rather than by causal biological and chemical relationships; the method used was step-wise linear multiple correlation. These results were used with actual local data as to occurrence of industry, and effluent characteristics determined from the literature. The resulting model can be used to relate possible specific changes in industrial growth to future water quality on the river. Economic inferences as to preferential growth patterns are derived. (Whipple-Rutgers)
W70-05643

NONLINEAR PROGRAMING APPLIED TO REGIONAL WATER RESOURCE PLANNING,
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 06A.
W70-05701

PROPOSAL FOR A U.S. NATIONAL WATER ATLAS,
National Research Council, Washington, D.C. Committee for the International Hydrological Decade.
For primary bibliographic entry see Field 07C.
W70-05707

ECONOMIC CONSIDERATIONS RELATIVE TO WATER QUALITY,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
For primary bibliographic entry see Field 05G.
W70-05708

JAMES RIVER BASIN COMPREHENSIVE WATER RESOURCES PLAN, VOLUME I -- INTRODUCTION.
Virginia Dept. of Conservation and Economic Development, Richmond. Div. of Water Resources.

Virginia Division of Water Resources Planning Bulletin 213, Vol I, March 1969. 193 p, 36 plate, 10 tab, 59 ref.

Descriptors: *Water resources development, *Planning, *Virginia, Hydrogeology, Rivers, Economics, Water requirements, Water supply, Water quality, Streamflow, Water yield, Water management (Applied), Data collections, Hydrologic data.
Identifiers: James River (Va).

The James River basin of Virginia extends from Hampton Roads on the east to the Virginia-West Virginia boundary on the west. It is the largest of the Virginia river basins, embracing one-fourth of the State's total area and is the home of more than two million people. The purpose of this study by the Virginia Division of Water Resources for the Board of Conservation and Economic Development is to examine the James River basin in light of its latest growth, to project the economy of the area to the year 2020, and to determine the quantitative water needs of the area for the future as well as for the present. Volume I is an introduction containing basic inventory data and descriptive material. The inventory includes: names of industrial and public water users and the latest available information on quantity of water withdrawn; listing of waste discharges and quantity of waste discharge; listing of current recreational development by type of activity; inventory of basin geology and estimates of current available groundwater; and current electric generating plant and major transmission facilities. (Knapp-USGS)
W70-05724

A NATIONAL ESTIMATE OF PUBLIC AND INDUSTRIAL HEAT REJECTION REQUIREMENTS BY DECADES THROUGH THE YEAR 2000 A.D.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. T. Jaske, J. F. Fletcher, and K. R. Wise.
67th National Meeting of the AIChE, Atlanta, Paper No. 37A, February 17, 1970, 23p, 9 fig, 3 tab, 10 ref.

Descriptors: *Population, Cooling towers, Temperature, Industrial plants, Solar radiations, Forecasting, Transportation, Electric power production.
Identifiers: *Heat rejection, *Energy consumption.

Population estimates are made and per capita energy use is projected. During the next 30 years an overall doubling of the gross consumption and release of energy per capita is projected, while the electrical energy consumption on the same basis is projected to increase by a factor of 5.2. This growth will occur primarily in the use of electricity to replace traditional heat sources in the conversion industries and for space heating. Despite the remarkable reduction in the heat requirements for the production of steel using the basic oxygen process and other projected new reduction processes, total energy use by industry is expected to increase about twice as fast as factors directly related to population. It is projected that total energy release to environment will exceed 190,000 trillion Btu per year by the year 2000. Release rates in the Boston-Washington metropolis is projected to exceed 30% of the incident annual solar energy by the same year. Electrical consumption of a single new building in New York will exceed 80,000 kilowatts. If the total national energy requirement from 1970-2000 had to be served by direct evaporation devices such as cooling towers, the incremental

electrical capacity of 1,040 GW requires a consumptive flow of 31,200 cfs of water for evaporation alone. This sums to a total of approximately 24,000,000 acre ft. a year, about twice the flow of the entire Colorado river. (Upadhyaya-Vanderbilt)
W70-05787

ALTERNATIVE METHODS OF FINANCING WASTE TREATMENT FACILITIES,
Union Securities and Co., New York.
For primary bibliographic entry see Field 05D.
W70-05804

COMPARISON OF DETERMINATION OF ORGANIC COMPOUNDS IN RETTING WASTE WATERS BY CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND METHODS (IN POLISH),
For primary bibliographic entry see Field 5A.
W70-05873

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

SOCIAL COSTS OF BUSINESS ENTERPRISE,
K. W. Kapp.
In Controlling Pollution: The Economics of a Cleaner America, Englewood Cliffs, Prentice-Hall, 1967, p 82-90, 9 p.

Descriptors: *Water pollution, *Cost-benefit analysis, *Pollution abatement, *Water resources, *Ecology, *Economics, Taxes, Management, Water supply, Air pollution, Environment, Recreation, Investment, Health, Topography.
Identifiers: *Social costs, *Social ecology, *External diseconomies, *Cumulative causation, Economic losses.

This article is concerned with the social costs of business enterprise. A social cost is defined if it: (1) is possible to avoid; (2) part of the course of productive activities; and (3) shifted to third persons or the community at large. Much of water pollution can be traced to productive activities and is man-made, avoidable and effects individuals other than the producers. The economic factors operating in a private enterprise economy increase the probability of incurring social costs. The author suggests a standard of social minima where social costs would be measured in terms of deficiencies from this minima. The social cost aspect of water pollution is well known and the author discusses the role of cost-benefit analysis in the evaluation process. (Murphy-Rutgers)
W70-05580

TRANSFER RESTRICTIONS AND MISALLOCATIONS OF IRRIGATION WATER,
Utah State Univ., Logan. Dept. of Agricultural Economics, and Iowa State Univ., Ames. Dept. of Economics.
For primary bibliographic entry see Field 03F.
W70-05605

AN ALTERNATIVE PROCEDURE FOR THE OPTIMIZATION OF OPERATIONS FOR PLANNING WITH MULTIPLE RIVER MULTIPLE PURPOSE SYSTEMS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 06A.
W70-05776

THIRD CLASS CITIES (SEWER CONSTRUCTION-COSTS).

Mo Ann Stat secs 88.597 thru 88.600 (1952).

Descriptors: *Missoure, *Cities, *Sewers, *Construction costs, Legal aspects, Legislation, Assessments, City planning, Engineering structures, Sewage, Sewage disposal, Sanitary engineering, Construction, Utilities, Taxes, Laterals.

Special tax bills pay for sewer construction costs, including the erection of all necessary disposal plants. Third class cities may by ordinance cause the construction of sewers, including disposal plants, in or for any sewer district. Any sewer may by ordinance be changed, diminished, enlarged or extended and shall have all the necessary laterals, inlets and other appurtenances which may be required. The computation of costs for tax bills is regulated. Third class cities are not liable for the cost of constructing, changing, diminishing, enlarging or extending any sewer, or the cost of erecting any disposal plant. (Powell-Florida)
W70-05824

6D. Water Demand

COOPERATIVE CITY-COUNTY RATE STRUCTURES,
Baltimore County, Md.; and Burns and Roe, Inc., Oradell, N.J.
For primary bibliographic entry see Field 06B.
W70-05578

WATER AND THE SOUTHWEST,
Virlis Fischer.
American Forests, Vol 73, No 11, p 14-17, 71-73, November 1967. Map.

Descriptors: *Arid lands, *Southwest U.S., *Water shortage, *Water supply, *Water demand, Arizona, California, Nevada, Semiarid climates, Overdraft, Groundwater mining, Groundwater, Water utilization, Water conservation, Irrigation water, Recreation demand, Municipal water, Industrial water, Human population, Water pollution, Desalination, Inter-basin transfers, Colorado River, Colorado River basin, Colorado River compact.
Identifiers: Central Arizona Project, North American Water and Power Alliance (NAWAPA).

Water has always been the major resource problem in the arid Southwest, but water experts warn that the area is now facing the greatest water crisis in the history of the United States. Basically, the water shortage is due to population, pollution, and progressively increasing demands caused by the American standard of living. Present water supplies are not even adequate to maintain the currently existing level of development in the Southwest and the Colorado River is already overcommitted. The situation obviously is serious when the groundwater overdraft in the Gila River basin of Arizona is 2,200,000 acre-feet per year. Although national and international schemes (such as the North American Water and Power Alliance) have been put forward as possible answers to the water supply question, it appears that the regional approach is the most useful at the present time. Within this approach more efficient use of presently-existing water supplies is necessary, but it seems that the regional water shortage will be solved only by desalination of salt water or by importation of water from other areas. (Carr-Arizona)
W70-05609

NONLINEAR PROGRAMING APPLIED TO REGIONAL WATER RESOURCE PLANNING,
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 06A.
W70-05701

WATER FOR THE DYER,
T. H. Morton.
Journal of the Society of Dyers and Colourists, Vol. 83, No. 5, p 177-184, 1967.

Descriptors: *Water supply, *Waste water disposal, *Water quality, *Waste water treatment, Surface runoff, Legislation, Surfactants, Alkylbenzene-sulfonate.
Identifiers: *Textile mill wastes, *Dyehouse wastes, Wool grease, Dyestuffs, Dyehouse wastes.

The dye industry of England and Wales uses approximately 10% of the annual surface water runoff. Increasing use, uneven distribution, and water management problems are discussed in terms of the dyeworks water supply and effluent disposal. Water quality required and processes used to produce satisfactory waters for the dyeworks are discussed in relation to surface, impounded or subsurface supplies. Effluent disposal for dyehouse waste waters are under control of local or river authority by prearrangement. Dilution in municipal waste waters may simplify treatment where biological processes are acceptable. On-site treatment is likely to be more complex. Certain surfactants, dyes, and auxiliary agents may correspond to alkylbenzensulfonate in treatability. Process modification to provide effluents more ameanable to treatment includes substitution of dyes with more favorable color removal, recovery of grease and fatty acid, and reselection of surfactants and auxiliary agents. These alterations increase costs but are essential under present and anticipated conditions. (Mattox and Livengood-North Carolina State University)
W70-05871

6E. Water Law and Institutions

A FEDERAL VIEW OF WATER POLLUTION CONTROL,
Federal Water Pollution Control Administration, Washington, D.C.
William F. Keating.
Environmental Control Management, Vol 138, No 5, p 19-40, November 1969.

Descriptors: *Laws, Social aspects, Federal jurisdiction, State jurisdiction, Water pollution control, Water pollution sources, Water Quality Act, Water quality control, Cost sharing, Financing, Technological feasibility.

An interview with the Commissioner of the Federal Water Pollution Control Administration of the US Department of the Interior, reveals that inadequately treated municipal sewage and industrial wastes are the major sources of pollution. Federal legislation has provided funds to construct waste treatment facilities, for research and demonstrations, and to assist state pollution control programs. The Water Quality Act of 1965 gave states the option of prescribing standards or using Federal government guidelines; all states elected to draft their own. 1972 is the deadline for compliance. Initial responsibility for standards enforcement rests with states, but Federal intervention via court rulings can result. Technological problems are: finding economic methods to treat wastes, counteracting acid mine drainage, oil spills, and agricultural pollution (including pesticide contamination), and solving the combined storm and rain sewer problem. Municipal bonds should be able to finance pollution control programs, although revenue bonds and service charges will tend to finance treatment plants. Present programs are advances, but problems are not always solved when requirements are met. Vigilance, pressure, and research are still needed. (Powers-Wisconsin)
W70-05548

GRACI V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR FLOOD DAMAGE).
301 F Supp 947-956 (ED La 1969).

Descriptors: *Louisiana, *Flood damage, *Damages, *Federal government, Structures, Navigable waters, Construction, Projects, Channel flow, Judicial decisions, Floods, Channel improvement, Costs, Levees, Navigation Legal aspects, Mississippi River, Flood protection, Outlet works, Legislation.
Identifiers: Flood Control Act of 1928.

Plaintiffs, private landowners, sued the United States for damages arising from the flooding of

their property during a hurricane, alleging that the flooding was caused by negligent construction of a navigation channel. The United States here requested a rehearing on its motion to dismiss. The government argued that article 3 of the Flood Control Act of 1928, which states that no governmental liability shall arise from flood damage, overrode any waiver of immunity under the Federal Tort Claims Act. The court held that article 3 above did not necessarily override the Tort Claims Act's waiver of immunity in the particular circumstances of this case. The court discussed several cases dealing with the federal government's liability for floodwater damage. It was pointed out that the structure here was not a flood control project but a navigation aid, and the court held that article 3 could not be interpreted as a wholesale immunization from all liability for floodwater damage unconnected with flood control projects. (Caldwell-Florida)
W70-05627

A STUDY OF INSTITUTIONAL FACTORS AFFECTING WATER RESOURCE DEVELOPMENT IN THE LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 06B.
W70-05641

UNITED STATES v 2,457.85 ACRES OF LAND (CONDEMNATION VALUE OF LAND TAKEN BY FLOOD CONTROL PROJECT).

303 F Supp 883-889 (S D Miss 1969).

Descriptors: *Eminent domain, *Compensation, *Mississippi, *Condemnation value, Legal aspects, Levees, Flood control, Condemnation, Judicial decisions, Benefits, Federal government, United States, Floodways, Flooding, Floodwater, Flood damage.

Plaintiff United States, exercising the power of eminent domain, acquired the land involved in this litigation to provide for flood control. Portions of the land condemned for the floodway had been periodically flooded subsequent to the completion of a levee constructed as part of the floodway but prior to condemnation. The sole issue was the amount of just compensation due for the condemnation of the tracts of land. The court held that just compensation was to be determined as of the date of taking but fair market value was to be determined as though the levee had not been constructed. The fact that no crops had been planted in the flooded fields and no claim for damages to crops was made did not preclude a finding that the land had been damaged as to its marketability by becoming a part of the floodway before condemnation. (Powell-Florida)
W70-05653

WATER SUPPLY - SANITATION - DITCHES (REMOVAL OF DRIFT).
Ohio Rev Code Ann secs 6153.01 thru 6153.26 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Obstruction to flow, *Stream improvement, *Aquatic drift, Running waters, Barriers, Legislation, Streamflow, River flow, Alteration of flow, Channels, Diversion, Channel improvement, Streams, Banks, Channel flow, Flow, Driftwood, Sand bars, Silts, Sediments, Legal aspects, Local governments.

A person injured by a drift or other obstruction in the channel or on the banks of a watercourse not on his land may enter the land and remove the obstruction. Notice must be given if the land is occupied. Such person is liable for any avoidable injury to the rights of the owner or occupant, and he may not remove from the land the substances composing the drift. The county, after notice to the person responsible, may remove any obstruction which blocks the free flow of any watercourse or which endangers any road. Taxpayers may petition the county for removal of any obstruction at the county's expense. The county may also remove obstructions upon petition by the adjacent landowner if removal is in the public interest. If the land benefited by the removal is in two or more counties, the commissioners of each county must meet to apportion the work. Provisions are made for notice and hearing on the various petitions. Appeal is made to the probate court and is heard before a jury. The county has the same power to keep a channel clear as it has to clear it initially. (Douberley-Florida)
W70-05660

PORT AUTHORITIES (ESTABLISHMENT, AUTHORITY, AND REGULATION OF PORT AUTHORITIES).
Ohio Rev Code Ann secs 4582.01 thru 4582.20 (Page, 1965), as amended, (Supp 1970).

Descriptors: *Ohio, *Port authorities, *Harbors, *Lake Erie, Legal aspects, Legislation, Cities, Federal government, State governments, Interagency cooperation, Water resources development, Administration, Lakes, Channels, Channel improvement, Drainage systems, Recreation facilities, Riparian land, Riparian rights, Docks, Piers, Costs, Taxes, Navigation, Eminent domain, Right-of-way, Easements, Watercourses (Legal).

Any municipal corporation or county may create a port authority or may join an existing port authority. A county creating a port authority must fully compensate the municipalities within the county for their prior waterfront investments. A board of directors governs each port authority. A port authority may: (1) purchase, construct, and operate commercial and recreational facilities; (2) improve any watercourse necessary to development of port facilities; (3) issue bonds to finance authorized activities; (4) exercise the power of eminent domain when necessary for the construction or efficient operation of any of its facilities; (5) enter into contracts or agreements with other governmental agencies; and (6) contract for construction or improvement of facilities in accordance with certain enumerated restrictions. Procedures are established which enable the owners of land abutting Lake Erie and within the jurisdiction of a port authority to enter into leases of adjacent submerged land from the state for purposes of constructing improvements. The Director of Public Works must approve leases of this type. (Casey-Florida)
W70-05661

MUNICIPAL CORPORATIONS- SALE OR LEASE OF PROPERTY (USE, LEASE AND CONTROL OF LAKE ERIE WATERS AND SOIL).
Ohio Rev Code Ann secs 721.04, 721.05, 721.09, 721.11 (Page, 1953), as amended, (Supp, 1970).

Descriptors: *Ohio, *Lake Erie, *Cities, *Land development, Legislation, Municipal water, Landfills, Land forming, Land management, Docks, Bulkhead line, Bulkheads, Coastal structures, Piers, Highways, Road construction, Assessments, Cost repayment, Cost allocation, Cost sharing, Shores, Littoral, Legal aspects, Land tenure, Real property, Land use.

Municipal corporations bordering Lake Erie may operate docking and terminal facilities on municipal property or on artificially filled state property beyond the shoreline. They may also regulate the establishment of harbor lines and other encroachments on the territory. Municipal authority over existing land, or land created by filling, extends two miles beyond the natural shoreline and is subject to any rights of the federal government. Land filled or improved by the upland owner may not be taken by the municipality without following the procedures provided. Rentals collected for the use of such land or facilities may be used only for the improvement of navigation and water commerce. Any municipality having jurisdiction over waterfront property may develop the waterfront by constructing bulkheads and filling property out to the bulkheads. Land benefited by such development may be assessed for the cost of same, and bonds may be issued in anticipation of the assessments. (Douberley-Florida)
W70-05771

FISH AND GAME--PRESERVES AND RESTORATION PROJECTS (GAME FISH MANAGEMENT AND PROTECTION).
Tenn Code Ann secs 51-601 thru 51-616 (1966).

Descriptors: *Tennessee, *Administrative agencies, *Fish management, *Fish conservation, Fish, Fishing, Fish stocking, Bodies of water, Regulation, Supervisory control (Power), Federal government, Recreation, Projects, Waterfowl, Wildlife conservation, Legal aspects, Legislation, Taxes, Leases, Financing, State jurisdiction.
Identifiers: *Fish preserves, *Fish restoration, Penalties (Criminal), Reservations.

The Game and Fish Commission has the power to establish reservations, refuges or wildlife management areas for the protection and propagation of fish, and shall expend funds to stock reservations with fish. Criminal penalties are provided for unlawful trespass and taking of fish on reservations. The Commission has the power to acquire waters for fish preserves and to execute contracts for the purchase, sale or lease of such preserves. Delinquent tax lands may be a source for establishment of fish preserves. The method of payment for fish preserves is described. The Governor may designate certain waters as fish preserves. The Commission may set aside state waters as fish preserves and establish regulations concerning the taking of fish from such preserves. The state consents to the purchase of waters by the United States government to further wildlife conservation. The state assents to federal aid in fish restoration and management projects. The Director of the Commission is empowered to acquire the exclusive fish rights of privately owned waters, and such rights shall include the power to regulate the fishing in such areas. The Director may sublet these rights to other governmental agencies. (Duss-Florida)
W70-05772

MUNICIPALLY OWNED UTILITIES: FIRST, SECOND, THIRD, AND FOURTH CLASS CITIES.

Mo Ann Stat secs 91.090 thru 91.300 (1952).

Descriptors: *Missouri, *Public utilities, *Water works, *Local governments, Water supply, Pipelines, Water costs, Water delivery, Contracts, Water distribution (Applied), Water rates, Water requirements, Buildings, Easements, Right-of-way, Reservoirs, Financing, Administrative agencies, Construction, Construction costs, Compensation, Cities, Legislation.
Identifiers: Revenue bonds, Liens.

First, second, third, and fourth class cities and special charter cities of 3,000 to 150,000 inhabitants may erect, acquire, maintain and operate waterworks to supply water to inhabitants and to persons beyond the city limits. Reasonable rates may be charged for water so supplied. Every such city may purchase all equipment necessary for a waterworks system or may purchase a system currently in operation in the city. If approved by popular election, the city may issue revenue bonds in the manner provided to finance the acquisition and operation of the waterworks. The system shall be controlled and managed by a board of waterworks commissioners and a waterworks manager who may issue these bonds which shall constitute a first lien on the waterworks property. Provisions are made for construction contracts when no waterworks are already in operation in the city. The city shall pay the board of waterworks commissioners for all water furnished to the city for fire protec-

tion, street cleaning, and consumption by public agencies. Private recipients shall also pay reasonable rates for water furnished to them. (Dearing-Florida)
W70-05775

CONDEMNATION OF PRIVATE PROPERTY (THIRD CLASS CITIES).

Mo Ann Stat sec 88.497 (1952).

Descriptors: *Missouri, *Condemnation, *Channel improvement, *Cities, Community development, City planning, Legislation, Legal aspects, Urbanization, Utilities, Easements, Eminent domain, Right-of-way, Watercourses (Legal), Rivers, Public benefits, Parks.

Third class cities may condemn private property for public use for the purpose of establishing, opening, widening, extending or altering any wharf, creek, river, watercourse or public park and for any other necessary public purpose. (Powell-Florida)
W70-05785

ORDINANCES FOR PUBLIC WORKS (SECOND CLASS CITIES).
Mo Ann Stat sec 88.400 (1952).

Descriptors: *Missouri, *Cities, *Financing, *Bridge construction, Public utilities, Community development, Construction costs, Legislation, Legal aspects, Urbanization, Project planning, Cost allocation, Construction, Maintenance, Utilities, Bridges, Culverts, Sewers, Highways, Local governments, Repairing.

Second class cities are empowered to repair and reconstruct any paving, macadamizing, guttering or curbing and to construct, reconstruct, and repair sidewalks, bridges, culverts, sewers and crosswalks. The cost of bridges, culverts, public sewers and footwalks across streets, avenues, alleys and other highways is paid out of the general revenue fund of the city. (Powell-Florida)
W70-05798

POWER TO LEVY AND COLLECT TAXES FOR GENERAL REVENUE PURPOSES, AND TO IMPROVE STREETS, ALLEYS, SIDEWALKS, BRIDGES, ETC. (THIRD CLASS CITIES).
Mo Ann Stat sec 88.507 (1952).

Descriptors: *Missouri, *Cities, *Assessments, *Bridge construction, City planning, Community development, Urbanization, Legal aspects, Legislation, Civil engineering, Engineering structures, Taxes, Construction maintenance, Maintenance costs. Construction costs, Bridges, Culverts, Roads, Utilities, Financing.

Third class cities are empowered to build and repair sidewalks, bridges, culverts and crosswalks. The cost of bridges, culverts, and footwalks across streets and alleys are paid out of the city's general revenue fund. Allocation and assessment of construction and repair costs are regulated. (Powell-Florida)
W70-05818

ARKANSAS STATE HIGHWAY COMM'N V ORMOND (COMPENSATION FOR CONDEMNED LAND).
448 SW 2d 354-364 (Ark 1969).

Descriptors: *Arkansas, *Judicial decisions, *Condemnation, *Condemnation value, Eminent domain, Legal aspects, Right-of-way, Compensation, Water law, Land appraisal, Land development, Land resources, Fish farming, Fish, Fisheries, Fish hatcheries, Catfishes, Administrative agencies, Highways.

Appellant highway commission condemned a portion of land owned by appellee. Appellee was awarded $12,000 as just compensation. Appellant contends that appellee's valuation of the taken land, based on its potential income when used to raise catfish, was improperly admitted into evidence because appellee was not a commercial fisheries expert. Appellee contended also that there was no substantial evidence to support the verdict. There was testimony by a real estate agent valuing the land at $17,100. The court held that appellee's testimony as to the proposed use of the land was admissible, but that his opinion as to its value for such purpose should have been excluded. However, the admission of appellee's testimony was not prejudicial since the valuation of the land by other witnesses was sufficient to justify an award of $12,000 by the jury. The highest and best use of a landowner's property, and its value, is a question for the jury. Judgment affirmed for appellee. (Dye-Florida)
W70-05835

WATER RESOURCES (PEARL RIVER VALLEY WATER SUPPLY DISTRICT ACT).
Miss Code Ann secs 5956-51 thru 5956-53, 5956-55 thru 5956-58, 5956-61, 5956-63 thry 5956-67, 5956-77 (Supp 1968).

Descriptors: *Mississippi, *Water conservation, *Water districts, *Water resources development, Water resources, Legal aspects, Legislation, Water policy, Water utilization, Water quality, Channels, Surface waters, Water management (Applied), Multiple-purpose projects, Non-structural alternatives, Project purposes, Water allocation (Policy), Water quality control, Pollution abatement, Water conveyance, Watershed management, Water storage, Environmental sanitation, Structures.

The waterways and surface waters of Mississippi are among its basic resources. The preservation, conservation, storage and control of such waters are necessary to insure an adequate, sanitary water supply, to promote the balanced economic development of Mississippi and to aid in flood control, conservation and development of state forests, land irrigation and pollution abatement. Toward the accomplishment of these purposes, as they relate to the Pearl River, there may be organized the Pearl River Valley Water Supply District which may: (1) impound the overflow and surface water of the Pearl River by the construction of dams, reservoirs, works, plants and other factilities; (2) constuct or acquire all works, plants, or other necessary facilities for the purpose of processing and transporting water to cities for domestic, municipal, commercial, industrial, agricultural and manufacturing purposes; (3) control open channels for water delivery purposes; (4) forest and reforest the project area and prevent soil erosion and floods within the area; (5) control, preserve, and store the Pearl River waters for land irrigation and water pollution prevention; and (6) overflow and inundate any public lands and public property within the project area. (Powell-Florida)
W70-05837

WATER RESOURCES (PEARL RIVER VALLEY WATER SUPPLY DISTRICT ACT).
Miss Code Ann secs 5956-51 thru 5956-53, 5956-55 thru 5956-58 (Supp 1968).

Descriptors: *Mississippi, *Water resources, *Water districts, *Water resources development, Water conservation, Legal aspects, Legislation, Water policy, Water utilization, Channels, Surface waters, Water management (Applied), Multiple-purpose projects, Pollution abatement, Water quality, Environmental sanitation, Water storage, Non-structural alternatives, Eminent domain, Condemnation, Construction, Maintenance.

Mississippi's basic resources include its waterways and surface waters. Previously, such waters have not been fully conserved. Conservation of such waters is necessary to promote the economic development of the state. Preservation, conservation and control of the Pearl River waters are for the general welfare of all Mississippians. The Pearl River Valley Water Supply District is organized to implement the declared legislative policy in regards to the waterways and surface waters of Mississippi. The District is to be organized and established by a chancery court pursuant to a petition filed by the Pearl River Industrial Commission. The procedures for creation of the District, including proceedings after a petition is filed and hearings on the petition, are enumerated. (Powell-Florida)
W70-05838

WATER RESOURCES (PEARL RIVER VALLEY WATER SUPPLY DISTRICT ACT).
Miss Code Ann secs 5956-61, 5956-63 thru 5956-67, 5956-77 (Supp 1968).

Descriptors: *Mississippi, *Water resources development, *Water resources, *Water conservation, Water policy, Legal aspects, Legislation, Water utilization, Recreation facilities, Water management (Applied), Environmental sanitation, Water conveyance, Water quality control, State governments, Pollution abatement, Multiple-purpose projects, Channels, Surface waters, Regulation, Supervisory control (Power).

The Pearl River Valley Water Supply District is given the power to: (1) impound overflow water and the surface water of the Pearl River by constructing dams, reservoirs, works, plants and other facilities designed to control, store, preserve, use, distribute and sell such waters; (2) construct or acquire works, plants and other facilities designed to process and transport overflow or surface water to cities for domestic, municipal, commercial, industrial, agricultural, and manufacturing purposes; (3) control open channels for water delivery purposes; (4) aid in the prevention of damage to persons or property from Pearl River waters; (5) aid in the prevention of soil erosion and floods; and (6) control, store and preserve the Pearl River waters for land irrigation and for water pollution prevention. Powers relating to the management and regulation of the District's affairs are provided. The District shall establish or provide for public parks and recreational facilities and for the preservation of fish and wildlife. The Board of Directors of the District shall promulgate all regulations to secure, maintain and preserve the sanitary conditions of all reservoir water, to prevent water waste and to govern all recreational activities within the District. The District shall act jointly with political subdivisions of Mississippi and other states and with the federal government in the performance of the purposes and services authorized in the act. (Richard Powell-Florida)
W70-05839

ARKANSAS V TENNESSEE (DETERMINATION OF STATE BOUNDARY LINE).
90 S Ct 784-787 (1970).

Descriptors: *Arkansas, *Tennessee, *Boundary disputes, *Avulsion, Mississippi River, Boundaries (Property), Accretion (Legal aspects), Ownership of beds, Shores, Legal aspects, Streams, Streamflow, River flow, Alteration of flow, Running waters, Streambeds, Thalweg, Channels, Erosion, Judicial decisions, Beds under water, River beds, Channel morphology, Channel erosion, Meanders.

The State of Arkansas brought an action to settle a boundary dispute with the State of Tennessee. The established state line was the thalweg, or the streamboat channel, of the Mississippi River. The River had migrated northward and westward until 1912 when an avulsion occurred leaving Tennessee lands on the Arkansas side of the new river channel. The water in the thalweg became stagnant. The court affirmed the report of the special master which fixed the boundary in the middle of the old abandoned channel. The court stated that where a running stream that serves as a boundary is changed naturally and gradually by erosion and accretion, the boundary follows the varying course of the stream. However, where the stream suddenly

forms a new bed by the process of avulsion, and the water in the old channel becomes stagnant, the boundary is not changed. The boundary then becomes fixed in the middle of the old abandoned channel, irrespective of subsequent changes in the new channel. The gradual filling of the channel's bed that follows is treated as an effect of the avulsion and not as an accretion to the shores. (Douberley-Florida)
W70-05840

REETZ V BOZANICH (CONSTITUTIONALITY OF COMMERCIAL FISHING REGULATIONS).
90 S Ct 788-790 (1970).

Descriptors: *Alaska, *Permits, *Commercial fishing, *Regulation, Salmon, Fishing gear, Judicial decisions, Jurisdiction, Legal aspects, Commercial fish, Nets, State governments, Federal government, Legislation.
Identifiers: Licenses, Constitutional law.

According to applicable Alaska laws, salmon net gear licenses for commercial fishing could be issued only to those who had held a license for that specific area since 1965 or who had held a commercial fishing license for any three years since 1960 and had actually fished that area. Appellees, nonresident fishermen, could not qualify for a salmon net gear license and challenged these laws as violative of both the state and federal constitutions. The Alaska Constitution provided that fish in their natural state were reserved to the people for common use, and that no exclusive right of fishery could be created. The District Court denied appellant's motion to dismiss or to stay the proceedings pending determination of the Alaska constitutional question by Alaska courts. The Supreme Court held that the federal court should have stayed its determination until the state constitutional question had been resolved. The constitutional provisions had never been interpreted by an Alaska court, and a state court decision conceivably could have avoided any decision under the fourteenth amendment. (Douberley-Florida)
W70-05841

UNITED STATES V REYNOLDS (DETERMINATION OF THE SCOPE OF THE PROJECT IN CONDEMNATION PROCEEDINGS).

90 S Ct 803-809 (1967).

Descriptors: *Eminent domain, *Condemnation value, *Project planning, *Compensation, Federal government, Condemnation, Projects, Legal aspects, Judicial decisions, Project purposes, Optimum development plans, Reservoirs, Recreation facilities, Cost repayment, Federal project policy.
Identifiers: Just compensation, Project scope.

The United States brought an action to condemn respondent's land for a reservoir project. Respondent claimed that a portion of the land was for recreational facilities adjacent to the project and was not within the original scope of the project. If the land was outside the project itself, the rule of just compensation would require that any increase in the market value attributable to the proximity of the project be taken into account. The District Court submitted to the jury the issue of the scope of the project. The Supreme Court reversed, finding that the issue should have been determined by the judge. The Court stated that there is no constitutional right to a jury in eminent domain proceedings, and the Federal Rules of Civil Procedure provide for a jury trial only on the issue of just compensation. The Court limited the issue of just compensation to the narrow question of the amount of compensation to be awarded. All other issues, including the issue of the scope of the project, are for the judge to determine. (Douberley-Florida)
W70-05842

LITZEL V CANAL AUTHORITY (TITLE ACQUIRED BY EMINENT DOMAIN FOR RECREATIONAL PURPOSES).

230 So 2d 164-166 (1st D C A Fla 1969).

Descriptors: *Florida, *Eminent domain, *Judicial decisions, *Condemnation, Legal aspects, Canals, Administrative agencies, State governments, Legislation, Projects, Land tenure, Recreation, Recreation facilities.

The Canal Authority of Florida, in an eminent domain proceeding, sought a fee simple title to land which it planned to use primarily for recreational purposes. The district court of appeal held that the question of whether a condemnor should be awarded a fee simple title to property depended on the necessity for such title. The court found no authorization for the Authority's acquisition of lands for recreational purposes. To award a fee simple title to the condemnor would deprive the owner of his property without due process of law. (Hubener-Florida)
W70-05843

SPORTMEN'S ENTERPRISES, INC V UNION BARGE LINE CORP (DEFINITION OF A NARROW CHANNEL).
306 F Supp 1376-1388 (N D Miss 1969).

Descriptors: *Mississippi, *Boating regulations, *Downstream, *Mississippi River, Channel flow, Rivers, Streamflow, Streams, Upstream, Channel morphology, Channels, Waterways, Legal aspects, Navigation, Navigable waters, Navigable rivers, Streambeds, Admiralty.
Identifiers: *Narrow channel.

On investigation of a collision between two towboats in the Mississippi River the court determined that the particular rules of navigation which should have been observed depended on whether or not the site of collision was a narrow channel. The court stated that whether or not the area was a narrow channel was a mixed question of law and fact which had to take into account the size and depth of the channel. (Hubener-Florida)
W70-05844

FONTENELLE V OMAHA TRIBE OF NEBRASKA (OWNERSHIP OF ACCRETION).

298 F Supp 855-862 (D D C 1969).

Descriptors: *Nebraska, *Land tenure, *Accretion (Legal aspects), *Boundary disputes, Riparian land, Riparian rights, Boundaries (Property), Surveys, Mapping, Navigable rivers, Judicial decisions, State governments, Avulsion, Bank erosion, Meanders, Ownership of beds, Missouri River, Legal aspects, Third party effects, River beds.
Identifiers: *Reliction.

Plaintiffs brought an action to quiet title to property formed by the movement of the Missouri River after the official United States survey was made. The court found that the change was caused by reliction, and stated that reliction was governed by the principles relating to accretion. The general rule is that land added by accretion and reliction to tracts which were riparian at the time of official survey and mapping is the property of the riparian owner. As the plaintiffs' property was riparian land at the time of the survey, they were entitled to the lands in question. The fact that the lands in question were originally included in an Indian reservation under United States patent did not call for the application of different rules and principles than would ordinarily be applied. (Caldwell-Florida)
W70-05846

VILLAGE OF GULFPORT V BUETTNER (NECESSITY OF CITY ORDINANCE AUTHORIZING CONDEMNATION OF PROPERTY FOR RECREATIONAL USE).

251 N E 2d 905-909 (3d Dist Ill. 1969).

Descriptors: *Illinois, *Condemnation, *Recreation facilities, *Legislation, Judicial decisions, Cities, Docks, Marinas, Boat-launching ramps, Recreation, Boating, Governments, Public rights, Legal aspects, Eminent domain, Local governments, Project planning, Real property, Harbors, State governments, Federal government, Construction.
Identifiers: Ordinances.

Plaintiff municipality initiated a condemnation proceeding for land to be used for a recreational harbor. The municipality had adopted a resolution to establish the harbor and acquire the property pursuant to the status authorizing the proceedings. Defendant challenged the proceedings on the grounds that the requisite ordinance was not passed by the municipality and that no approval had been obtained from the proper state and federal authorities. The trial court denied plaintiff's motion to amend and allege approval by the government officials and dismissed the petition. The appellate court affirmed. It found that the building of a launching ramp was within the provision authorizing the construction of harbors. The statutory procedures required the municipality to adopt an ordinance prescribing a permanent rule of conduct relating to the improvement. The resolution submitted by plaintiff was not sufficient to satisfy the statute because a resolution is only of special and temporary character. (Douberley-Florida)
W70-05895

6G. Ecologic Impact of Water Development

NEW CONCEPT FOR MANAGING AQUATIC LIFE SYSTEMS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
John Cairns, Jr.
Journal, Water Pollution Control Federation, Vol. 42, No. 1, p 77-82, Jan. 1970. 12 ref.

Descriptors: *Environment, *Management, *Quality control, *Warning systems, Bioassay, Aquatic life.
Identifiers: Simulation, Biological information system, Life support functions.

In the past, our response to environmental problems has been almost entirely defensive. This response pattern is not effective, and management and planning are badly needed. Some prerequisites for making full use of natural ecosystems without damaging them are: predictions systems which can predict the consequences of various types and intensities of environmental use; simulation techniques, approximating various uses of the environment and the consequences of all combinations and intensities of use; rapid biological information systems, both 'in-stream' and 'in-plant' which will permit environmental quality control as well as an early warning of impending problems; and the identification of the life support functions of our environment and the requirements of the essential components. (Speakman-Vanderbilt)
W70-05795

07. RESOURCES DATA

7A. Network Design

THE METHODS OF STUDYING THE FREE UNCONFINED GROUNDWATER REGIME IN IRRIGATION REGIONS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 04B.
W70-05731

PRINCIPLES ON NETWORK DESIGN AND BASIC DATA TO STUDY GROUNDWATER BALANCE,
Research Inst. for Water Resources Development, Budapest (Hungary).
K. Ubell.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 56-63, 1968. 8 p, 2 fig, 7 ref.

Descriptors: *Hydrologic data, *Network design, *Aquifers, Hydraulic properties, Hydrologic properties, Water table, Piezometers, Water quality, Discharge (Water), Soil moisture, Tracers, Radioisotopes.
Identifiers: Groundwater data collections.

The study of groundwater balance requires three types of closely interrelated hydrologic measurements. These 3 types are: (1) Constant or nearly constant measurements obtained from single-type surveys showing the geometry, physical and chemical properties of water-bearing formations, hydraulic properties of aquifers and soil hydrological constants; (2) dynamic measurements, including data on water table, piezometric head, discharge, water quality, temperature data, soil moisture and its state of tension; (3) additional observations such as those obtained by use of lysimeters, tracers, environmental isotopes, etc. The basic data necessary to compute the groundwater balance are discussed in more detail for each category. (Carstea-USGS)
W70-05736

RAIN GAGE SPACING AND REPORTED RAINFALL,
Universidad Central de Venezuela, Caracas; and Texas A and M Univ., College Station.
Fernando Alvarez, and Walter K. Henry.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 97-107, March 1970. 11 p, 10 fig, 2 tab, 8 ref. Contract No DAAB07-69-C0203.

Descriptors: *Rain gages, *Network design, Data collections, Surveys, Meteorological data, Statistical methods, Hydrologic data, Regional analysis, Stations.
Identifiers: Guyana, Colombia, Rain-gage networks.

A study was made of the variation of observed rainfall over several areas as related to the density of rain gages. Daily, monthly, and mean rainfall observations are each considered as a function of rain gage density. A study was made of the variation in isohyetal patterns which would be obtained if a variable number of stations was utilized. Numerous maps of each network were analyzed. In all cases the isohyetal patterns became more complex as more stations were utilized. The number of rain gages needed to determine the correct total rainfall for an area appears to depend upon three factors. First is the terrain - if mountainous, more gages are required. Second is the climatic area - the spacing depends upon the mean diameter of the rainstorms. Whenever the rain gage network has gages spaced at a distance less than the diameter of the mean rainstorms, the accuracy of measurement increases. Third is the type of data required - if accurate daily data are needed, the density of gages must be much greater than if monthly totals are needed and a still larger spacing will suffice if long-term means are desired. Better results will be obtained with more gages and with a more uniform spacing. By using the given relationships, the number of gages needed for a specific area can be estimated. In the final consideration, the cost of supporting the network will be the deciding factor. (Knapp-USGS)
W70-05878

7B. Data Acquisition

SAMPLING THE BENTHOS,
Toronto Univ. (Ontario). Dept. of Zoology.
R. O. Brinkhurst.
Great Lakes Institute, University of Toronto, Canada, PR 32, November 1967. Mimeo 7 p. 1 fig.

Descriptors: *Sampling, *Benthos, Specifications, Evaluation.

The ideal benthos sampler, thus far non-existent, should have the following specifications: penetration of at least 20 centimeters, the bite such that all depths are sampled equally in one attempt, a powerful closing mechanism, and a descent toward sediment without a pressure wave. A review of advantages and shortcomings of now available samplers (Kajak, Freshwater Biological Association, England, Jenkin, Orange-peel, Peterson, Wildlife Supply Company's 'Ponar Dredge', Franklin, Ekman, and Benthos Inc), leads to the conclusion that Hydrobios Apparat Gebau of Kiel, Germany, makes the best available but still in need of modification. (Wilde-Wisconsin)
W70-05557

CONTINUOUS MONITORING OF SOIL MOISTURE TENSION PROFILES,
Agricultural Research Service, Fresno, Calif. Soil and Water Conservation Research Div.; and Nevada Bureau of Mines, Reno. Desert Research Inst.
For primary bibliographic entry see Field 02I.
W70-05592

LABORATORY METHOD FOR SUPPLYING MOISTURE UNIFORMLY TO SOIL BY CONDENSATION,
Battelle Memorial Inst., Richland, Wash.; North Dakota Univ., Grand Forks. Dept. of Engineering; Oregon State Univ., Corvallis. Dept. of Mathematics; and Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-05594

THE USE OF THE COULTER COUNTER FOR THE DETERMINATION OF MARINE PRIMARY PRODUCTIVITY,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
D. H. Cushing, H. F. Nicholson, and G. P. Fox.
Journal du Conseil International pour l'Exploration de la Mer, Vol 32, No 1, p 131-151, 1968. 18 fig, 2 tab, 12 ref.

Descriptors: *Sea water, *Analytical techniques, Sampling, Instrumentation, Primary productivity, Standing crop, Detritus, Algae, Reproduction, Chlorophyll, Phytoplankton, Grazing, Nutrients, Copepods.
Identifiers: Particle method, Coulter counter, Reproductivity rate, Carbon-14, Optical density, Particle volume, Faroe Islands (Denmark), Grazing experiment, Pulse amplitude/digital converter.

The Coulter counter consists of two vessels connected by a small tube, all filled with an electrolyte; electrodes immersed in each vessel register the variation in the current produced by particles passing through the connecting tube. Addition of a pulse height analyzer and a pulse amplitude/digital converter permitted estimation of standing crop of phytoplankton, detritus, and reproductive rate on samples of raw sea water near the Faroe Islands (Denmark). The advantages of this particle method are: observations can be made in seconds on very small quantities of water (2 milliliter), and a high degree of replication can be obtained in a few minutes. Limitations of carbon-14 and chlorophyll methods of phytoplankton analyses are pointed out. (Wilde-Wisconsin)
W70-05650

QUANTITATIVE MICRO-DETERMINATION OF LIPID CARBON IN MICROORGANISMS,
California Univ., San Diego, La Jolla. Inst. of Marine Resources; and Scripps Institution of Oceanography, La Jolla, Calif. Div. of Marine Biology.
O. Holm-Hansen, J. Coombs, B. E. Volcani, and P. M. Williams.
Analytical Biochemistry, Vol 19, No 3, p 561-568, 1967. 1 fig, 1 tab, 17 ref.

Descriptors: *Analytical techniques, *Microorganisms, *Lipids, Light, Algae, Temperature, Carbon dioxide, Oxidation, Chemicals, Carbon, Gravimetry.
Identifiers: Chloroform-methane extracts, Lipid carbon, Chloroplasts, Infrared analysis.

The described procedure for the quantitative determination of lipid in microorganisms employs combustion of the solvent extracts to carbon dioxide and measurement of the liberated carbon dioxide by infrared analysis. The method permits analyses of samples containing as little as 20 micrograms of lipid, and the results are comparable to those obtained by gravimetric and colorimetric methods. (Wilde-Wisconsin)
W70-05651

INFLUENCE OF METHOD FOR REMOVAL OF SESTON ON THE DISSOLVED ORGANIC MATTER. II. COBALAMINS,
Washington Univ., St Louis, Mo. Dept. of Botany.
Bruce C. Parker.
Journal of Phycology, Vol 5, No 2, p 124-127, 1969. 1 tab, 5 ref.

Descriptors: *Analytical techniques, *Organic matter, *Seston, Vitamin B, Water chemistry, Chemical analysis, Filtration, Centrifugation, Dialysis, Bioassay, Euglena, Sewage, Lakes, Water pollution effects, Missouri, Scenedesmus, Adsorption, Rainfall, Water pollution sources.
Identifiers: *Organic solutes, *Cobalamins, Vitamin B-12, Millipore filtration, Biodialysis, Continuous flow centrifugation, Error analysis, Westchester Lake (Mo), Coulet counter, Haemacytometer enumeration, Membrane filters, Occlusion, Euglena gracilis Z bioassay.

Study of organic solutes in natural waters necessitates removal of organisms and particulate detritus. Usual methods of sample treatment, including filtration and centrifugation, influence water composition. A previous study describes effects of seston removal on total dissolved carbon by continuous flow centrifugation, Millipore filtration, and biodialysis. Investigations have been extended to examine recovery of cobalamins (vitamin B-12), which may be a more sensitive index. Cobalamins were estimated by bioassay in which growth of Euglena gracilis Z is assessed by counting cells with Coulter counter or in haemacytometer. Cobalamin concentrations reported range from less than 0.25 to 16.0 picograms/milliliter. Results indicate several probable sources of error: unpredictable occlusion of pores of Millipore membrane during filtration; irreversible cobalamin adsorption by filter; and cell injury and leakage during centrifugation. While soluble cobalamin, for some samples, were in good agreement among three methods, others showed discrepancies. Validity interpretation of total versus sestonic cobalamin-determinations should consider such variations. Biodialysis is usually equally acceptable as other methods. This technique involves placing in situ a chamber containing sterile distilled water retained between two membrane filters; dialysis of organic solutes from ambient water into chamber proceeds to equilibrium, whereas seston is excluded. (Eichhorn-Wisconsin)
W70-05656

DETERMINATION OF SOIL DENSITY AND WATER CONTENT BY FAST NEUTRONS AND GAMMA RAYS,
Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
For primary bibliographic entry see Field 02G.
W70-05682

A METHOD OF DERIVATION OF NONCONSTANT WATERSHED RESPONSE FUNCTIONS,
Agricultural Research Service, Athens, Ga. Southeast Watershed Research Center.

For primary bibliographic entry see Field 02A.
W70-05685

THE PRINCIPAL CRITERIA OF THE ANALYSIS OF GEOPHYSICAL FIELDS IN HYDROGEOLOGICAL INVESTIGATIONS WITH SPECIAL REFERENCE TO DESERT REGIONS OF KAZAKHSTAN,
Kazakhstan Geophysical Agency, Alma-Ata (USSR); and All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
Yu. F. Anashin, V. V. Brodovog, A. P. Gavelya, R. N. Kirilov, and G. N. Zavarzin.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 249-261, 1968. 13 p, 9 fig.

Descriptors: *Geophysics, *Groundwater basins, *Surveys, Groundwater movement, Flow rates, Fresh water, Maps, Mapping, Magnetic studies, Seismic studies, Seismic properties.
Identifiers: *USSR, *Kazakhstan, Asia, Africa, Geophysical exploration.

Geophysical methods of groundwater prospecting such as electric, seismic, gravity, and magnetic surveys have been extensively used in the drought areas of Kazakhstan. Geophysical data in connection with geological and hydrological information are used to determine the extent and depth of water-bearing strata, the degree of mineralization of groundwater, and the direction and rate of groundwater flow. Geophysical data are presented as: (1) geophysical field maps; (2) structural contour maps; (3) electric and seismic geological cross sections; and (4) maps of hydrogeological prediction. Experience obtained in Kazakhstan can be used in other desert regions of Asia and Africa. (Carstea-USGS)
W70-05728

THE USE OF AIRPHOTO-INTERPRETATION TECHNIQUES IN WATER RESOURCES SURVEYS,
Caesar Voute.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 75-80, 1968. 6 p, 17 ref.

Descriptors: *Water resources, *Aerial photography, *Aquifers, Base flow, Surveys, Water loss, Dams, Dam foundations, Slope stability, Phreatophytes, Water table, Saline water, Brackish water, Halophytes, Remote sensing.
Identifiers: Airphoto interpretation.

Distinction between areas with low, moderate, high and very high permeability and with large or small base flows is possible by the interpretation and measurement of various features observed on single aerial photographs using stereoscopic pairs. Geological photo-interpretation combined with hydrogeological and geotechnical appraisal of the features observed will indicate the existence of underground losses from reservoirs or at damsites, as well as type of foundation and slope stability. Phreatophytes may indicate areas with shallow watertable whereas halophytes and white efflorescences are good indicators of brackish or saline groundwater. Color photography, infrared photography, special film/filter combinations and remote sensing techniques are getting more and more attention in hydrological studies. (Carstea-USGS)
W70-05734

USE OF ALGAL CULTURE METHODS IN EUTROPHICATION RESEARCH (IN NORWEGIAN),
Norsk Institutt for Vannforskning, Blindern.
For primary bibliographic entry see Field 05C.
W70-05752

AN AUTOMATED SYSTEM FOR THE DETERMINATION OF CHEMICAL OXYGEN DEMAND,
Upper Tame Main Drainage Authority, Birmingham (England).
For primary bibliographic entry see Field 05A.
W70-05762

SEDIMENT MEASUREMENT TECHNIQUES: E. AIRBORNE SEDIMENT.

Prepared by Task Committee on Preparation of Sedimentation Manual ASCE Committee on Sedimentation of the Hydraulic Division. ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7001, p 29-41, January 1970. 13 p, 6 fig, 43 ref.

Descriptors: *Dusts, *Measurement, *Sampling, *Monitoring, Air pollution, Aerosols, Particle size, Data collections, Test procedures, Analytical techniques, Filtration, Turbulence, Mixing, Sediment transport.
Identifiers: Dust measurement.

Measuring sensors and collectors and analysis methods for measuring and analyzing aerial dusts are presented. Plastic sheets, trays, and cups; glass beakers; outer cylinders of raingages; the Nipher snowgage with inverted bell shield; the Toronto and detroit collectors; and the dual purpose sequential sampler employing microscope slides are some of the devices which use the sedimentation or settling technique for making dustfall measurements. Filtration, impingement, electrostatic precipitation, thermal precipitation, and centrifuging principles are used in devices for measuring suspended aerosol contaminants. Fiber and membrane or molecular filters, the Greenburg-Smith and midget impingers, the cascade impactor, the Chatfield sequential and the CERL directional suspension samples, and the Goetz centrifugal sampler are examples of the devices employing some of these principles. Special collectors that have been used to measure aerial dust originating from wind erosion are described. Techniques and instruments for chemical, morphological, and count and size analyses of airborne sediment are also presented. (Knapp-USGS)
W70-05886

A NEW RECORDING TURBIDITY METER FOR RIVERS,
Natal Univ., Durban (South Africa).
William James.
International Association Scientific Hydrology Bulletin, Vol 15, No 1, p 91-95, March 1970. 5 p, 6 fig, 1 ref.

Descriptors: *Turbidity, *Light penetration, *Instrumentation, Opacity, Optical properties, Sediment transport, Suspended load, On-site tests.
Identifiers: Turbidity meters.

An expensive continuously recording turbidity transducer on two different types of mounting has been developed at the University of Natal, and installed at two stations in the Umgeni River system. The geometry and components of the transducers are detailed, and a sampler used to calibrate the transducers is also described. A portable turbidity meter has also been developed. (Knapp-USGS)
W70-05901

7C. Evaluation, Processing and Publication

PROPOSAL FOR A U.S. NATIONAL WATER ATLAS,
National Research Council, Washington, D.C. Committee for the International Hydrological Decade.
L. A. Heindl.
Water Resources Bulletin, Vol 6, No 1, p 1-6, January-February 1970. 6 p, 5 ref.

Descriptors: *Water resources, *Mapping, Data collections, Hydrologic data, Hydrogeology, Hydrology, Geology, Water quality, Stream gages, Observation wells, Climatology, Meteorology, Sedimentology.
Identifiers: National Water Atlas (USA).

The U. S. National Committee for the International Hydrological Decade is proposing a National Water Atlas as a contribution to the improvement of the quality of information available for this Nation's large-scale planning and management studies. The atlas would provide hydrological maps of the United States and its principal basins and of its territories. The nationwide maps would be at a scale of 1:5,000,000 and the 17 principal basins at 1:2,500,000. The principal basins will be those delineated by the Water Resources Council. Wherever feasible and appropriate, the data will be presented with a common standard period of record, preferably 1941-70, as a base. Map subjects would include station networks, radiation, precipitation, snow and ice, evaporation, atmospheric vapor fluxes, surface-water discharge, groundwater storage and discharge, chemical quality, sediment discharge, water temperatures, and soil moisture. The list of map subjects and types of data shown within each subject are flexible and open-ended so that additional maps could be added to the atlas as information is available or as new needs arise. (Knapp-USGS)
W70-05707

METHODS OF GROUNDWATER BALANCE EVALUATION APPLIED IN THE USSR - DEVELOPMENT OF METHODS OF STUDY OF GROUNDWATER BALANCE,
For primary bibliographic entry see Field 02F.
W70-05727

METHODS OF GROUNDWATER UNSTEADY FLOWS THEORY,
Akademiya Nauk SSSR. Dept. of Applied Hydrodynamics.
For primary bibliographic entry see Field 02F.
W70-05730

ESTIMATION OF GROUNDWATER BALANCES IN ENGLAND,
Institute of Geological Sciences, London (England).
Stevenson Buchan.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 126-134, 1968. 9 p, 1 fig, 31 ref.

Descriptors: *Water balance, *Water resources, *Water storage, Geologic mapping, Aquifers, Wells, Boreholes, Water levels, Meteorological data, Streamflow.
Identifiers: *England, Groundwater balance.

Geological maps on the scale of 1:63,360 for the whole county and 1:10,560 for about a third of it were used for estimation of groundwater balances of the important aquifers in England. The pattern of underground drainage and changes in the level of storage was defined by using information from several hundred-thousand shafts, wells, boreholes, and water level measurements at some 600 sites. Meteorological data and streamflow measurements were also used. Regional and formational groundwater balances in England were initiated by the Institute of Geological Sciences. The water balances are revised at intervals of not more than seven years and are used for computing the water resources of the county. (Carstea-USGS)
W70-05732

THE ARCHIVES FOR GROUNDWATER LEVELS T.N.O. IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, The Hague (Netherlands).
J. H. Beltman.

In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 64-74, 1968. 11 p, 4 fig, 3 ref.

Descriptors: *Water levels, *Data collections, *Artesian wells, Theoretical analysis, Climatic data, Forecasting, Network design, Research and development, Observation wells, Statistical methods.
Identifiers: Netherlands.

The main purposes of the Archives for Groundwater Levels T.N.O. in the Netherlands are: (1) To collect data of groundwater levels, observed over long periods with a certain frequency in a certain number of observation points for both phreatic and artesian water throughout the Netherlands; (2) to supply, without charge, data on groundwater levels to all interested parties; and (3) to serve for organization of 'Secondary Archives'. The selection of key wells was such that each point was representative of a certain area. A theoretical analysis for such a selection is given. The system allows examination, explanation and prediction of the behavior of groundwater levels with various climatological conditions. The close network of observation points for groundwater levels is indispensable for any hydrological research in the Netherlands. (Carstea-USGS)
W70-05735

COMPUTER AIDED DESIGN OF WASTE WATER TREATMENT PLANTS,
Michigan Univ., Ann Arbor. Dept. of Environmental Health.
For primary bibliographic entry see Field 05D.
W70-05777

NEW CORRELATIONS AND TABLES OF THE COEFFICIENT OF VISCOSITY OF WATER AND STEAM UP TO 1000 BAR AND 1000 DEG C,
Glasgow Univ. (Scotland).
E. A. Bruges, B. Latto, and A. K. Ray.
Int. J. Heat Mass Transfer, Vol. 9, p 465-480, 1966. 9 fig, 7 tab, 46 ref.

Descriptors: *Temperature, *Thermal properties, *Viscosity, Steam, Heated water, Physical properties, Viscometers, Pressure, Vapor pressure, Rheology, Water vapor, Vapor.

New correlations and tables of the coefficient of viscosity of water and steam are presented. The correlations have the same general format as those appended to the International Skeleton Tables (800 bar, 700 deg C) but take account of recent work, thus permitting values up to the higher limits of 1000 bar and 1000 deg C to be derived. The paper gives references to all the leading works and recommends that systematic and extensive measurements be made in the temperature range 0-400 deg C at all pressures. (Novotny-Vanderbilt)
W70-05783

REAL-TIME COMPUTER CONTROL OF URBAN RUNOFF,
Minneapolis-St. Paul Sanitary District, St. Paul, Minn.
James J. Anderson.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7028, p 153-164, January 1970. 12 p, 19 fig, 10 ref. FWPCA Grant No 1-MINN.-1.

Descriptors: *Runoff, *Urbanization, *Water control, *Digital computers, Drainage systems, Flow control, Monitoring, Gaging stations, Water management (Applied), Computer programs.
Identifiers: Minneapolis-St. Paul (Minn), Urban hydrology.

Computer control and modernization of combined sewer overflow regulators and an urban hydrology hydraulic mathematical model are described. The system was installed to control the Minneapolis-St. Paul sewer system during stormwater runoff to improve the utilization of the existing interceptor sewers. Key stormwater regulators were modified to provide remote control of hydraulically operated gates and inflatable dams. Trunk sewer and interceptor sewer level monitoring stations and rain gages are used as input to a mathematical model consisting of: (1) rainfall-runoff model; (2) stormwater diversion model; and (3) flood routing in the interceptor sewer. A high density river quality monitoring system was installed to determine quality effects of runoff events and to evaluate the effectiveness of the control system. Automatic sampling and automated wet chemical analysis of wastewater are used to identify hourly quality variations in the wastewater. (Knapp-USGS)
W70-05882

A NATIONAL WATER DATA SYSTEM FOR CHILE,
Geological Survey, Washington, D.C.
William W. Doyel, and Marshall E. Moss.
Geological Survey Open-file report, Marsh 1970. 141 p, 1 fig, 7 append.

Descriptors: *Hydrologic data, *Data storage and retrieval, *Foreign countries, Water measurement, Snow surveys, Automation, Data processing, Standards, Compatability, Coordination, Water resources, Precipitation (Atmospheric), Hydrogeology, Water users, Project planning.
Identifiers: *National water-data system, *Chile, Program planning, Information centers.

At the request of the Chilean Government for assistance in developing a centralized coordinated water data system, a study was made of the current status of data acquisition in Chile and a series of recommendations were developed for specific action. A national water data system is outlined. A unique number system for data sites is presented; formats and forms designed for a catalog of water information are described. Data storage systems are proposed and the total system is outlined with regard to acquisition, flow through, responsiveness, and feedback. A coordinated mechanism involving data acquirers and/or users is suggested. (Land-USGS)
W70-05892

08. ENGINEERING WORKS

8A. Structures

METHOD FOR DETERMINING MINIMUM-COST FARM-IRRIGATION PIPELINE DESIGN,
Soil Conservation Service, Milford, N.H.
For primary bibliographic entry see Field 03F.
W70-05597

THE EFFECTS OF WAVES AND CURRENTS ON SUBMERGED PIPELINES,
Texas Engineering Experiment Station, College Station. Coastal and Ocean Engineering Div.
Derwood O. Ralston, and John B. Herbich.
Available from the Clearinghouse as PB-188 106, $3.00 in paper copy, $0.65 in microfiche. Sea Grant Pub-301, Coastal and Ocean Engr Div Report, COE-101, March, 1969. 128 p.

Descriptors: *Ocean waves, *Pipelines, Submergence, Ocean currents, Seashores, Failure (Mechanics), Maintenance, Costs, Sedimentation, Oil industry, Environment effects, Corrosion.
Identifiers: *Underwater pipelines.

The report is a brief review and summary of selected literature pertaining to the effects of waves and currents on submerged pipe lines.
W70-05619

DESIGN AND CONSTRUCTION OF THE WEI-RIVER BRIDGE IN WU-LING. A HINGED TEE RIGID STRUCTURE BRIDGE OF BUILT-UP PRESTRESSED REINFORCED CONCRETE CANTILEVERS.
Foreign Technology Div., Wright-Patterson AFB, Ohio.

Trans. of T'u Kung Ch'eng Hsueh Pao. Kung Ch'eng Chieh Kou (Mainland China) v 12 n 1 p 2-14, 52 1966. Available from the Clearinghouse as AD-699 233, $3.00 in paper copy, $0.65 in microfiche. Foreign Technology Div Rept no FTD-HT-23-1164-68, 8 Aug 69. 41 p.

Descriptors: *Bridges, *Railroads, *Bridge construction, Cantilevers, Reinforced concrete.
Identifiers: *Cantilever bridges, *Concrete construction, Rigid frame bridges, Prestressed concrete, Translations.

A report is given on the design and construction of the Wei River bridge at Wu-ling, Honan. This bridge is built with prestressed reinforced concrete. It has three spans: the middle span is 50 meters, and the two side spans are 25 meters each. The total length is 105.2 meters. The paper provides extensive data on design, selection of material, construction sequences, and construction techniques.
W70-05620

HYDROLOGIC EFFECTS OF FLOODWATER-RETARDING STRUCTURES ON GARZA-LITTLE ELM RESERVOIR, TEXAS,
Geological Survey, Austin, Tex.
C. R. Gilbert, and S. P. Sauer.
Geological Survey Open-file Report, September 1969. 126 p, 38 fig, 21 tab, 41 ref.

Descriptors: *Flood control, *Check structures, *Reservoir yield, *Reservoirs, *Texas, Dams, Reservoir operation, Water yield, Trap efficiency, Mathematical models, Computer programs, Hydrology, Water balance, Hydrologic budget, Reservoir evaporation, Reservoir silting, Hydrologic data, Data collections, Groundwater, Bank storage.
Identifiers: Garza-Little Elm Reservoir (Texas).

The effects of systems of floodwater-retarding structures on downstream water and sediment yield were studied in northern Texas. The project includes 11 study areas ranging from 18 to 80 sq mi in size and from 0 to 67% controlled by floodwater-retarding structures. Average annual runoff ranges from about 2 to 7 inches. This report presents results of analyses, development of methodology, and results of application of methods for defining the downstream effects of systems of floodwater-retarding structures. Trap efficiency of most floodwater-retarding structures was found to be about 97%. Average annual water consumption ranged from 1.57 inches of equivalent runoff in the most eastern study area, where annual runoff averaged 6.96 inches, to 0.77 inch of equivalent runoff in the most western study area, where the average annual runoff was 2.35 inches. A mathematical response model of the floodwater-retarding reservoir systems and the entire drainage basin yields monthly water and sediment inflow to the water-supply reservoir. Results of the firm-yield study indicated that with full development annual firm yield would have been initially reduced by 10%. After 30 or more years, when the permanent pools of the floodwater-retarding reservoirs would have been mostly filled with sediment, the firm yield was found to be almost the same with or without the upstream development. (Knapp-USGS)
W70-05637

SEVERAL DYNAMIC PROGRAMMING ALGORITHMS AND THEIR APPLICATION TO A DAM PROBLEM,
California Univ., Berkeley. Operations Research Center.
For primary bibliographic entry see Field 06A.
W70-05770

THERMAL POLLUTION: STATUS OF THE ART,
Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 05D.
W70-05778

THE EVAPORATION OF DROPS OF PURE LIQUIDS AT ELEVATED TEMPERATURES: RATES OF EVAPORATION AND WET-BULB TEMPERATURES,
Wisconsin Univ., Madison.
Carl G. Downing.
A.I.Ch.E. Journal, Vol. 12, No. 4, p760-766, July, 1966. 6 fig, 1 tab, 45 ref.

Descriptors: *Evaporation, *Heat transfer, Mass transfer, Evaporators, Temperature, Thermal properties, Condensers, Evaporation pans, Evaporation control, Air-water interfaces, Heating, Saturation, Vapor pressure, Water loss.

The rates of evaporation at the wet-bulb temperatures have been correlated for drops of pure liquids evaporating in streams of high-temperature air. The four liquids studied were acetone, benzene, n-hexane, and water. The drops were on the order of a millimeter in diameter and were suspended in a free jet of dry, vapor-free air that ranged in temperature from 27 deg C to 340 deg C. Reynolds numbers ranged from 24 to 325. Corrections to the Nusselt number to account for the heat lost to the outwardly-diffusing vapor ranged up to about 35%. Main conclusions are: (a) Drop vibration has no effect upon the rate of drop evaporation, and (b) film theory analysis gave a first-order approximation to the correlation correction at high rates of heat and mass transfer. (Upadhyaya-Vanderbilt)
W70-05793

8B. Hydraulics

BEACH CYCLES IN SOUTHERN CALIFORNIA,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
Francis P. Shepard.
Available from the Clearinghouse as AD-699 397, $3.00 in paper copy, $0.65 in microfiche. Beach Erosion Bd, Technical Memorandum no 20. July, 1950. 31 p.

Descriptors: *Beaches, *Beach erosion, *Ocean waves, Structures, Particle size, Storms, Tides, Periodic variations, Oceanography.
Identifiers: Submarine canyons, Winter.

The large waves accompanying winter storms cause a widespread denudation of southern California beaches. During the summer period of small waves the sand is brought back, completing an annual cycle. The beach berms vary in width with the seasonal changes so that in general they are widest at the end of summer and narrowest at the end of winter. Variation in berm width is related also to the spring and neap tides, the berms being widest during neap tides and narrowest during spring tides. The cutting back of the berms often results in scarp formation at the top of the foreshore, the scarps being most commonly developed in the fall during the first period of large waves following the small waves of summer. In addition to offshore-onshore movements of sand there are also important lateral shifts. The sand is shifted along the beach in the direction in which the waves are approaching. As a result of this lateral shift the northwest storms of winter cause the southern ends of some beaches to grow during the winter, and the southerly approach during the summer moves the sand north and therefore produces a cut.
W70-05622

COMPLETENESS THEOREM FOR NON-SELFADJOINT EIGENVALUE PROBLEMS IN HYDRODYNAMIC STABILITY,
Rensselaer Polytechnic Inst., Troy, N.Y.
R. C. DiPrima, and G. J. Habetler.
Available from the Clearinghouse as AD-698 898, $3.00 in paper copy, $0.65 in microfiche. Archive for Rational Mechanics and Analysis, Vol 34, No. 3, p 218-227, 1969, 11 refs. Contract DA-31-124-ARO (D)-269.

Descriptors: *Hydrodynamics, Stability, Equations.
Identifiers: Eigenvalues, Orr-Somerfeld equation.

A number of problems in the linear theory of hydrodynamic stability lead to Eigenvalue problems of the form (L - lambda M)phi=0. Here L and M are ordinary differential operators or ordinary matrix differential operators, and phi is a scalar function or a vector function on a finite interval which satisfies appropriate homogeneous boundary conditions at the endpoints. Perhaps the best known example is the classical Orr-Sommerfeld equation, which arises in a study of the stability of plane parallel viscous flow to two dimensional disturbances. A Second class of problems occurs in a study of the stability of a layer of fluid heated from below (the Benard problem) or the stability of the viscous flow between rotating concentric cylinders (the Taylor problem). A general theorem is obtained which is an extension of NAIMARK's theorem and which is applicable to the Taylor stability problem as well as to the parallel flow stability problem and to various generalizations of these problems. The generalized Taylor stability problem and the Orr-Sommerfeld equation are considered.
W70-05632

TRACER AIDS INTERPRETATION OF PUMPING TEST,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 05G.
W70-05678

A FINITE ELEMENT SOLUTION OF THE ONE-DIMENSIONAL DIFFUSION-CONVECTION EQUATION,
California Univ., Davis.
Gary L. Guymon.
Water Resources Research, Vol 6, No 1, p 204-210, February 1970. 7 p, 1 tab, 9 ref. NSF Grant GZ-790.

Descriptors: *Flow, *Open channel flow, *Groundwater movement, *Diffusion, *Convection, *Equations, Mathematical studies, Computers, Computer programs, Data processing.
Identifiers: Finite difference method.

The one-dimensional diffusion-convection equation has been widely used to describe approximately the transient motion of a subset of particles in river flow or porous media flow. An equivalent variational principle to the governing partial differential equations of motion is given, and a finite element solution is developed requiring only approximations in the space domain. The solution is applicable to a wide variety of field problems because it can account for a variety of boundary conditions. Additionally, the solution is not dependent upon constant parameters of motion over the entire domain of interest. (Knapp-USGS)
W70-05681

SECONDARY FLOWS IN CURVED OPEN CHANNELS,
Kyoto Univ. (Japan). Disaster Prevention Research Inst.
Yoshio Muramoto.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A53, p 429-437, 1967. 9 p, 8 fig, 1 tab, 15 ref.

Descriptors: *Vortices, *Meanders, *Alluvial channels, Open channel flow, Mathematical studies, Boundary processes, Turbulence, Turbulent flow, Channel morphology, Steady flow, Water circulation, Model studies, Hydraulic models.
Identifiers: *Secondary flows.

The theoretical consideration of secondary flows is so complicated that most of previous studies are found to have been restricted to the analysis of the behavior of the flow in a fully developed region of the curved channel. The internal structure of curved flow is analyzed on the basis of the measurement of 3 velocity components and the calculation of vorticity components of the flow in a curved open channel. The flow in a curved section is divided into the following three regions in a mathematical model: a generating region; a developing region; and a fully developed region of the secondary flow. Several analytical results show the characteristics of the flow. (Knapp-USGS)
W70-05739

MODEL SIMILARITY AND TRAINING OF RIVER WITH LARGE CHANNEL IRREGULARITIES,
Hydraulic Research Inst., Prague (Czechoslovakia). Dept. of Technical Hydromechanics.
For primary bibliographic entry see Field 02E.
W70-05741

SOME RELATIONS OF ENERGY, ROUGHNESS, AND CHANNEL GEOMETRY IN THE LOWER MISSISSIPPI RIVER,
Corps of Engineers, Vicksburg, Miss.
For primary bibliographic entry see Field 02E.
W70-05742

AN APPROXIMATE THEORY OF SECONDARY FLOWS AT THE BEND OF THE RIVER COURSE,
American Inst. of Water Problems and Hydrotechnics, Yerevan (USSR).
For primary bibliographic entry see Field 02E.
W70-05744

SECONDARY CURRENTS IN CURVED STRATIFIED RIVERS,
Manchester Univ. (England). Inst. of Science and Technology.
For primary bibliographic entry see Field 02E.
W70-05745

SOME ASPECTS OF FLOW IN MEANDERING CHANNELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-05747

THERMAL REGIME OF TURBULENT BOUNDARY LAYERS AT CONSTANT PHYSICAL PROPERTIES WITH BLOWING, (IN FRENCH),
Aerodynamics Research Centre, Poitiers (France).
L. F. Tsen, and C. Quemard.
Int. J. Heat Mass Transfer, Vol 11, p1127-1139, 1968. 10 fig, 3 tab, 20 ref.

Descriptors: *Heat transfer, *Mass transfer, *Turbulent boundary layers, Turbulent flow, Turbulence, *Air circulation, Air masses, Reynolds number, Eddies, Viscosity, Diffusion, Momentum transfer, Evaporation.
Identifiers: Theory of heat transfer.

The mean energy equation of the homogeneous, incompressible turbulent boundary layer with blowing is numerically integrated and the Spalding number computed with the following assumptions: constant laminar and turbulent Prandtl numbers; constant rate of flowing or suction, step wall temperature distribution; and a unified low of the wall. The numerical results are compared with some measurements of velocity and temperature profiles in the boundary layer. Computations were performed for Prandtl numbers, Pr = 0.7 (heat transfer in air) Pr = 0.8 (Vapor diffusion) and Pr = 1 (momentum). (Novotny-Vanderbilt)
W70-05779

ON THE TURBULENT HEAT TRANSFER BY FREE CONVECTION FROM A VERTICAL PLATE,
Tokyo Univ. (Japan). Faculty of Engineering.
Hiroharu Kato, Niichi Nishiwaki, and Masaru Hirata.
Int. J. Heat Mass Transfer, Vol 11, p1117-1125, 1968. 9 fig, 1 tab, 9 ref.

Descriptors: *Heat transfer, *Convection, *Turbulence, Turbulent flow, Temperature, Thermal properties, Heat pollution, Thermal pollution, Diffusion, Viscosity, Boundary layers, Heat flow, Heating, Cooling, Buoyancy.

Until now, the problem on the turbulent heat transfer by free convection has been solved by the profile method whose velocity and temperature profiles are given by experiments. In this paper, shear stress, heat flux, and eddy diffusivity distribution are assumed using the result of forced convection heat transfer, then the coupled partial differential equations for velocity and temperature, which are reduced to simpler forms, can be easily solved by the trial and error method. The result can be applied for a wider range of Grashof and Prandtl numbers than that obtained from usual equations. On transition from laminar to turbulent, a certain dimensionless criterion is proposed, which gives the ratio of energy of mean flow and that dispersed near the wall. The same dimensionless value can be applied for both forced and free convection. (Novotny-Vanderbilt)
W70-05781

INTERNAL HYDRAULICS OF THERMAL DISCHARGE DIFFUSERS,
Tennessee Valley Authority, Norris. Engineering Lab.
For primary bibliographic entry see Field 05D.
W70-05788

EQUATIONS FOR THE MASS- OR HEAT-TRANSFER COEFFICIENT IN TURBULENT MOTION,
Institutul Politehnic Bucuresti (Rumania).
E. Ruckenstein.
Int. J. Heat Mass Transfer, Vol. 9, p441-451, 1966. 24 ref.

Descriptors: *Mass transfer, *Heat transfer, *Turbulence, Air-water interfaces, Surfaces, Reaeration, Boundaries, Turbulent flow, Open channel flow, Diffusion, Thin films.
Identifiers: Liquid films.

The renewal models used by several authors for representing the turbulent process in the vicinity of a boundary give only the dependence of the transfer coefficient on the diffusion coefficient or thermal diffusivity. In this paper, a number of ways are suggested by means of which this partial information supplied by renewal models may be completed with information of a hydrodynamic nature. The first one makes use of dimensional considerations similar to those used in the classical theory; the second way is based on the instability theory and the third one on certain assumptions concerning the form of the solutions of the equation of motion in the turbulent quasi-steady state. The first way is applied to the mass transfer in the vicinity of a solid boundary and also to the mass transfer in the vicinity of a fluid boundary. The other two ways are applied to the case of mass transfer in a liquid film moving along a vertical wall and to the case of heat transfer between a fluidized bed and a wall. A comparison between the physical model method and the classical one is also included. (Novotny-Vanderbilt)
W70-05789

THE PREDICTION OF THE TRANSPORT PROPERTIES OF A TURBULENT FLUID,
Glasgow Univ. (Scotland).
J. R. Tyldesley, and R. S. Silver.
Int. J. Heat Mass Transfer, Vol. 11, p 1325-1340, 1968. 10 fig, 1 tab, 19 ref.

Descriptors: *Mass transfer, *Heat transfer, *Turbulence, Velocity, Momentum equation, Reynolds number, Turbulent flow, Viscosity, Mixing, Temperature, Hydraulics, Eddies, Thermal pollution, Thermal conductivity, Thermal properties.

The transport properties of a turbulent fluid are investigated using a simple model to represent the detailed fluid behavior. In the model, this is attributed to the motions of fluid entities of varying size, shape and velocity, and an analysis is made to find the effect on the whole system, of interactions and transport between the individual entities. The analysis enables expressions to be found for the diffusivities of mass, momentum, and energy in terms of properties of the turbulence. Experimental values of the various diffusivity ratios compare favorably with the theoretical predictions. It is concluded that the model is a useful concept for predicting the bulk behavior in turbulent flow. (Novotny-Vanderbilt)
W70-05790

HEAT TRANSFER BIBLIOGRAPHY,
Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
E. R. G. Eckert, E. M. Sparrow, W. E. Ibele, and R. J. Goldstein.
Int. J. Heat Mass Transfer, Vol. 11, p583-603, 1968. 760 ref.

Descriptors: *Heat transfer, Mass transfer, Boundary layers, Conductivity, Evaporation, Cooling, Heating, Temperature, Thermal properties, Hydraulics, Air-water interfaces, Shear, Bibliographies, Reynolds number, Heat flow, Thermal radiation.
Identifiers: Heat transfer bibliography.

This bibliography contains 760 references on heat transfer problems. The literature review is divided into the following areas: (1) Applications of heat transfer (2) boundary layers problems, (3) change of phase and two-phase flow, (4) channel flow, (5) conduction, (6) heat and mass transfer, (7) liquid metals, (8) magnetohydrodynamics, (9) natural convection, (10) packed and fluidized beds, (11) radiation, (12) rotating surfaces or fluids, (13) thermodynamics and transport properties, (14) transfer mechanisms. (See also W70-05792). (Novotny-Vanderbilt)
W70-05791

HEAT TRANSFER BIBLIOGRAPHY,
Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
E. R. G. Eckert, E. M. Sparrow, W. E. Ibele, and R. J. Goldstein.
Int. J. Heat Mass Transfer, Vol. 11, p899-915, 1968. 585 ref.

Descriptors: *Heat transfer, Mass transfer, Temperature, Thermal properties, Turbulent flow, Boundary layers, Bibliographies, Convection, Conduction, Heating, Cooling, Channel flow, Heat budget, Heat balance, Enthalpy, Entropy, Latent heat, Thermal radiation, Evaporation, Thermal capacity, Water temperature, Melting, Heat pollution, Thermal pollution.
Identifiers: Thermal problems bibliography.

Comprehensive literature survey on heat transfer problems is presented. The bibliography contains 585 references on the following topics: (1) application of heat transfer theory, (b) boundary layers problems, (c) change of phase and two-phase flow, (d) channel flow, (e) conduction, (f) heat and mass transfer, (g) low density flow, (h) magnetohydrodynamics, (i) measurement techniques, (j) natural convection, (k) packed and fluidized beds, (l) radiation, (m) rotating surfaces or fluids, (n) thermodynamics and transport properties. (See also W70-05791). (Novotny-Vanderbilt)
W70-05792

FREE CONVECTION IN AN AIR-WATER VAPOR BOUNDARY LAYER,
Minnesota Univ., Minneapolis.
E. M. Sparrow, J. W. Yang, and C. J. Scott.
Int. J. Heat Mass Transfer, Vol. 9, p 53-61, 1966, 4 fig, 6 ref.

Descriptors: *Evaporation, Air-water interfaces, Diffusion, Heat balance, Heating, Latent heat, Heat transfer, Energy budget, Boundary processes, Boundary layers, Mass transfer, Evapotranspiration, Saturation, Radiation, Viscosity.

This paper describes an experimental investigation, supported by analysis, of free convection in an air-water vapor boundary layer at the stagnation point of a horizontal cylinder. A two-component boundary layer is created by the effusion of water vapor from the porous surface of the cylinder; the ambient gas is pure air. The results of both experiment and analysis indicate that the heat transfer decreases as the surface mass-transfer rate increases. At moderate blowing rates, there is a good agreement between the experimentally and analytically determined Nusselt numbers. At higher mass-transfer rates, the data lie above the analytical predictions by about 25 per cent. This departure is attributed to a fluctuating motion in the boundary layer. (Novotny-Vanderbilt)
W70-05794

BED TOPOGRAPHY EFFECT ON FLOW IN A MEANDER,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Chin-lien Yen.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7003, p 57-73, January 1970. 17 p, 6 fig, 1 tab, 11 ref, append. OWRR Project A-029-IA.

Descriptors: *Channel morphology, *Meanders, *Alluvial channels, *Hydraulic models, Open channel flow, Hydraulics, Streamflow, Sediment transport, Regime, Hydraulic similitude, Model studies, Topography.
Identifiers: Streambed topography.

Stabilized bed topography in a meandering channel with fixed walls and movable bed was measured at various width-depth ratios and Froude numbers. Velocity and bed-shear distributions were measured in a fixed-bed model whose configuration conformed to the stabilized topography of the movable-bed model. An approximate theoretical analysis of the bed configuration under fully developed flow conditions shows that the transverse bed slope is directly proportional to a parameter characterizing the relative importance of fluid inertia compared with the gravity acting on a particle. Good agreement has been observed between the theoretical and experimental results in the downstream half of the model channel. The effects of formation of the bed topography on the flow characteristics are considered. (Knapp-USGS)
W70-05887

RISKS IN HYDROLOGIC DESIGN OF ENGINEERING PROJECTS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7229, p 959-966, April 1970. 8 p, 3 fig, 1 tab, 5 ref. OWRR Proj No B-043-ILL.

Descriptors: *Flood control, *Reservoir design, *Risks, *Design criteria, *Probability, Hydrology, Decision making, Stochastic processes, Rainfall-runoff relationships, Synthetic hydrology, Flood forecasting, Hydraulic design, Mathematical studies.
Identifiers: Hydrologic design criteria.

By using the probability theory it has been shown that for any hydrologic design with a certain return period and expected life of a project there is always a calculated risk of failure involved. For a time invariant hydrologic system this simple risk can be computed. Conversely, if the expected project life and the simple risk are known, the corresponding

design return period can be determined. Such a determination of the return period is independent of the type of distribution and the plotting position of the hydrologic data. Furthermore, there are additional risks and uncertainties involved which should be considered in hydrologic design of engineering projects such as those due to limited record of data available, using rainfall records to synthesize runoff information, stochastic nature of the hydrologic system, and the techniques utilized in the mathematical processing of the data. (Knapp-USGS)
W70-05905

BOUNDARY SHEAR DISTRIBUTION IN OPEN CHANNEL FLOW,
Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.
S. N. Ghosh, and N. Roy.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7241, p 967-994, April 1970. 28 p, 22 fig, 3 tab, 18 ref, append.

Descriptors: *Open channel flow, *Boundary layers, Roughness (Hydraulic), Boundary processes, Current meters, Shear drag, Instrumentation, Model studies, Hydraulic models.
Identifiers: Boundary layer flow, Secondary flow, Boundary shear.

Boundary shear distribution in both rough and smooth open channels of rectangular and trapezoidal sections is obtained by direct measurement of shear drag on an isolated length of the test channel utilizing the technique of a three point suspension system suggested by Bagnold. Existing shear measurement techniques have been reviewed critically. Comparison of the measured distribution has been made with other indirect estimates, from isovels, and Preston tube measurements, based on Keulegan's resistance laws. The discrepancies between the direct and indirect estimates are explained. Of the two indirect estimates the surface pitot tube technique is found to be more reliable. The influence of secondary flow on the boundary shear distribution could not be accurately defined in the absence of a dependable theory on secondary flow. (Knapp-USGS)
W70-05907

8C. Hydraulic Machinery

ROTATING-BOOM PLOT IRRIGATOR WITH OFFSET MOUNTING,
Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch; and North Dakota State Univ., Fargo. Agricultural Experiment Station.
For primary bibliographic entry see Field 03F.
W70-05610

8D. Soil Mechanics

SPRINKLER INTENSITY AND SOIL TILTH,
Utah State Univ., Logan. Agricultural and Irrigation Engineering Dept.; and Utah Agricultural Experiment Station, Logan.
For primary bibliographic entry see Field 02G.
W70-05611

CONSTRUCTION OF A ROCK-FILL DAM BY LARGE-SCALE DIRECTIONAL DOWNTHROW BLASTS,
California Univ., Berkeley. Lawrence Radiation Lab.
R. V. Sedykh.
UCRL-Trans-10402, October, 1969, 25 p. Available from the Clearinghouse as PB-188 149T, $3.00 in paper copy, $0.65 in microfiche. Energeticheskoe Stroiteslstvo (USSR) n 85 p 35-41, Jul 68.

Descriptors: *Rockfill dams, Craters, Construction, *Excavation, Drainage, Rivers, Safety, Mudflows.
Identifiers: Downthrow blasts, Medeo (USSR).

Large-scale cratering and downthrow blasts find wide application in the construction of hydraulic engineering works. The use of blast energy for the formation of the main body of a rock-fill dam is of great interest. A typical example of such operations, which has recently been completed, is the construction of a mudflow protection dam in the locality of Medeo near the town of Alma-Ata.
W70-05624

UTILIZATION OF MARGINAL LANDS FOR URBAN DEVELOPMENT,
Partner, Mueser, Rutledge, Wentworth and Johnston, New York.
Philip C. Rutledge.
ASCE Proceedings, Journal Soil Mechanics and Foundations Division, Vol 96, No SM1, Paper 7000, p 1-22, January 1970. 22 p, 14 fig, 9 ref.

Descriptors: *Land development, *Urbanization, *Landfills, *Wetlands, Economics, Land use, Drainage, Land reclamation, Soil stabilization, Soil engineering, Soil mechanics, Costs, Planning, City planning.
Identifiers: *Marginal wetlands, Urban expansion.

The problems and costs of creating useful land from marginal wet lands around cities are becoming increasingly important to planners and engineers. Such lands are below water or occasionally flooded, are underlaid by soft and highly compressible organic alluvium, and frequently are covered by garbage and solid refuse. Making usable land requires fill to raise the grade above flooding. The major problem is excessive settlements under the load of this fill. Precompression by surcharge loading, possibly with sand drains, is required to minimize future settlements and make land acceptable for light buildings, streets, and municipal services. Heavier buildings require pile foundations extending through all compressible soils and pile supported waterfront structures may be required. The 1967 costs for land development range from $30,000 to $150,000 per acre and additional costs of foundations for nine-story buildings range from $9.00 to $17.00 per sq ft. Waterfront developments with deep water perimeters may cost upward of $300,000 per acre. Data are provided for estimating design requirements and site development costs on a comparable basis. (Knapp-USGS)
W70-05881

8H. Rapid Excavation

CONSTRUCTION OF A ROCK-FILL DAM BY LARGE-SCALE DIRECTIONAL DOWNTHROW BLASTS,
California Univ., Berkeley. Lawrence Radiation Lab.
For primary bibliographic entry see Field 08D.
W70-05624

8I. Fisheries Engineering

FISH AND GAME--PRESERVES AND RESTORATION PROJECTS (GAME FISH MANAGEMENT AND PROTECTION).
For primary bibliographic entry see Field 06E.
W70-05772

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

AQUATIC SCIENCES IN THE GREAT LAKES AREA.
For primary bibliographic entry see Field 09D.
W70-05738

9D. Grants, Contracts, and Research Act Allotments

AQUATIC SCIENCES IN THE GREAT LAKES AREA.

Interagency Committee on Oceanography Report No 4, Vol 2, 1967. 50 p, 3 index.

Descriptors: *Great Lakes region, *Hydrology, *Projects, *Research facilities, Grants, Programs, Research and development, Water resources, Lakes, Oceanography, Governments, Limnology, Hydrogeology, Biology, Great Lakes.
Identifiers: Great Lakes research, Water resources research.

Research projects in the Great Lakes at university and institutional laboratories, as well as of those conducted by agencies of the Canadian or United States Governments or by Provincial and State agencies are summarized and listed. For each project the title of project, principal investigator, sponsor, funding, if known, and purpose and nature of project are listed. In addition to the listing of projects under sponsoring agencies, several additional indices have been included for cross-referencing: principal investigators are listed alphabetically; projects are listed by function or subject; projects are listed by specific geographic location. (Knapp-USGS)
W70-05738

10. SCIENTIFIC AND TECHNICAL INFORMATION

THE ARCHIVES FOR GROUNDWATER LEVELS T.N.O. IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, The Hague (Netherlands).
For primary bibliographic entry see Field 07C.
W70-05735

HEAT TRANSFER BIBLIOGRAPHY,
Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 08B.
W70-05791

HEAT TRANSFER BIBLIOGRAPHY,
Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 08B.
W70-05792

A NATIONAL WATER DATA SYSTEM FOR CHILE,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-05892

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ANNUAL REPORT ON GROUND WATER IN ARIZONA, SPRING 1968 TO SPRING 1969.
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5 WATER QUALITY MANAGEMENT AND PROTECTION

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 15
AUGUST 1, 1970

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 15
AUGUST 1, 1970

W70-05908 -- W70-06314

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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U.S. Department of the Interior
Washington, D. C. 20240

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1B. Aqueous Solutions and Suspensions

CARBON DIOXIDE, CARBONIC ACID, AND BICARBONATE ION: PHYSICAL PROPERTIES AND KINETICS OF INTERCONVERSION,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 02K.
W70-06153

02. WATER CYCLE

2A. General

INFILTRATION ANALYSIS I-INTRODUCTION,
For primary bibliographic entry see Field 02G.
W70-05916

CLIMATES OF THE WORLD.
Environmental Science Services Administration, Rockville, Md. Foreign Branch of Environmental Data Service.
For primary bibliographic entry see Field 02B.
W70-05930

STORAGE AND DELIVERY OF RAINFALL AND SNOWMELT WATER AS RELATED TO FOREST ENVIRONMENTS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
Henry W. Anderson.
Proc. 3rd Forest Microclimate Symp. Seebe, Alberta, Sept. 23-26, 1969, p51-67, Canadian Forestry Service, Calgary, Alberta, March 1970.

Descriptors: *Microenvironment hydrologic cycle, *Rainfall disposition, *Watershed management, Snow management, Flood hydrology, *Forest soils, Snow cover, *Snowmelt, Interception, Retention, Soil water, Meteoric water, Condensation, Fog drip, Energy transfer, Water balance, Subsurface flow.
Identifiers: *Detention storage, Flow paths.

Accuracy of measurements of watershed inputs of rainfall, snowfall and atmospheric moisture are discussed. Outlines some of the fundamental entities of forest and water interactions, including some of the favored paths that water and energy take in the forest environment are outlined. The storage of water on forest surfaces and subsurfaces and the processes of delivery of water, as affected by forest conditions, are reviewed and discussed. The report summarizes what can be done in manipulating forests to modify snow storage and control snowmelt. (Anderson-Forest Service)
W70-06038

2B. Precipitation

CLIMATES OF THE WORLD.
Environmental Science Services Administration, Rockville, Md. Foreign Branch of Environmental Data Service.

Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 - Price $0.35 per copy. Environmental Science Services Administration Data Service Report, January 1969. 28 p. 3 fig, 1 tab.

Descriptors: *Climates, *Climatic data, Data collections, Weather data, Temperature, Precipitation (Atmospheric).
Identifiers: World climatic data.

The principal features of climates of all the continents are discussed briefly. Worldwide temperatures and precipitation are illustrated by maps. Monthly and annual temperatures and precipitation, including extreme temperatures, are presented in tabular form for approximately 800 stations throughout the world. Whenever possible, data are provided for at least one location in each country throughout the world. Cities in larger countries such as Canada, the USSR and the United States were selected to provide as complete a geographical coverage as possible. (Knapp-USGS)
W70-05930

A THREE PARAMETER DISTRIBUTION FOR PRECIPITATION DATA WITH A STRAIGHT-LINE PLOTTING METHOD,
Nevada Univ., Reno. Center for Water Resources Research.
C. K. Stidd.
Desert Research Institute Preprint No 56, Nevada University, May 1968. 5 p, 5 fig, 2 ref. OWRR Project No A-026-NEV.

Descriptors: *Precipitation (Atmospheric), *Weather forecasting, *Data processing, *Statistical methods, Meteorological data, Sampling, Statistics, Weather data.
Identifiers: Precipitation data.

A plotting method is described which yields a straight line if cubes of data are normally distributed. Reno rainfall is used as an example, and the mathematical interpretation is discussed. Data that plot as a curved line on a rectilinear paper will often plot as a straight line on logarithmic graph paper. The straight-line plot on log-log paper gives three parameters for a generalization of the ordinary Gaussian distribution. The time distribution of point precipitation amounts is often cube-root normal. This could be due to the fact that precipitation is a product function of vertical motion, moisture and duration time. (Knapp-USGS)
W70-05961

METEOROLOGICAL SATELLITE VIEWS OF CLOUD GROWTH ASSOCIATED WITH THE DEVELOPMENT OF SECONDARY CYCLONES,
National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.
For primary bibliographic entry see Field 07B.
W70-06127

INDIRECT SENSING OF ATMOSPHERIC WATER VAPOR,
For primary bibliographic entry see Field 07B.
W70-06159

PROBABLE MAXIMUM AND TVA PRECIPITATION FOR TENNESSEE RIVER BASINS UP TO 3,000 SQUARE MILES IN AREA AND DURATION TO 72 HOURS,
Weather Bureau, Silver Spring, Md. Office of Hydrology.
Francis K. Schwartz, and Norbert F. Halfert.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $1.75. Hydrometerological Report No. 45, May, 1969. 166 p, 26 tab, 95 fig, 33 ref, append.

Descriptors: *Probable maximum precipitation, *Spillway, Design criteria, *Weather patterns, Snowmelt, Water control, *Precipitation (Atmospheric), Rainfall.
Identifiers: TVA, Tennessee River, Tennessee.

Generalized procedures are developed to provide Probable Maximum Precipitation (PMP) and less extreme TVA precipitation estimates for Tennessee Watershed basins up to 3000 square miles in area and for durations to 72 hours. Specific estimates are presented for 28 basins mostly in the mountainous eastern portion of the Tennessee River Watershed. In addition, antecedent rainfall criteria are developed for use with the basic PMP and TVA precipitation estimates. These estimates are necessary for consistent spillway design. (Stahl-ESSA)
W70-06181

2C. Snow, Ice, and Frost

TRAFFIC TESTS ON PORTAGE LAKE ICE,
Cold Regions Research and Engineering Lab., Hanover, N.H.
H. W. Stevens, and W. J. Tizzard.
Available from the Clearinghouse as AD-700 130, $3.00 in paper copy, $0.65 in microfiche. Technical Rept., Dec 69, 70 p, Report no. CRREL-TR-99.

Descriptors: *Ice loads, *Lake ice, Ice breakup.
Identifiers: Cold weather operations, *Cold weather tests, *Floating ice, Ice formation.

A limited series of traffic tests were conducted on floating lake ice using a dual-wheel loaded to gross weights of 20,250; 28,250 and 36,250 lbs. Deflections were measured under static and moving loads on a continuous ice sheet and adjacent to a free edge. Representative samples of the ice were tested in unconfined compression, direct shear, flexure, and under a dyamic load (steady-state vibration). Crystal size and orientation were measured. An analysis of test results is presented using linear elastic theory and a method is proposed for estimating time variations of deflection.
W70-05966

STORAGE AND DELIVERY OF RAINFALL AND SNOWMELT WATER AS RELATED TO FOREST ENVIRONMENTS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02A.
W70-06038

ANALYSIS OF A 24-YEAR PHOTOGRAPHIC RECORD OF NISQUALLY GLACIER, MOUNT RAINIER NATIONAL PARK, WASHINGTON,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-06143

2D. Evaporation and Transpiration

THE INFLUENCE OF WINTER CATCH CROPS ON THE WATER BALANCE OF SOIL,
R. Lutzke.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 174-180, 1968. 7 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Water conservation, *Land management, *Evapotranspiration, *Water balance, Soil texture, Soils, Forages, Lysimeters, Water consumption, Soil moisture, Water loss, Water storage.
Identifiers: *Germany, Eberswalde station.

Evapotranspiration of a sandy soil cultivated during winter with forage plants increased by about 50 mm. The experiments were conducted in lysimeters of 1 square-meter and 1.5 m deep at the lysimeter station, Eberswalde, Germany. Evapotranspiration increased from April to May amounting to about 6 mm per day. A dry spring season reduces the soil moisture content in addition to water loss due to evapotranspiration by plants. In this situation, an early harvesting of the forage plants is recommended. In this way, the water shortage for the following crops is avoided. (Carstea-USGS)
W70-05933

TURFGRASS EVAPOTRANSPIRATION,
Agricultural Research Service, Boise, Idaho; Soil and Water Conservation Research Div.; and Nevada Agricultural Experiment Station, Reno.
Rhys Tovey, John S. Spencer, and Dean C. Muckel.

Agronomy Journal, Vol 61, No 6, p 863-867, November-December 1969. 2 fig, 5 tab, 9 ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Arid lands, *Turf grasses, *Lawns, Turf, Burmuda grass, Kentucky bluegrass, Fescues, Irrigation effects, Irrigation efficiency, Irrigation practices, Irrigation design, Lysimeters, Soil moisture, Water requirements, Nevada, Soil types, Loam.
Identifiers: Tifway, Tifgreen, Sandy loam, Overwatering.

Even though water is relatively expensive and in short supply in arid regions, lawns are generally overwatered. In light of this fact, a study was instituted to evaluate the water requirements of turfgrass. Since knowledge of evapotranspiration is necessary in order to design an efficient irrigation system and establish an effective schedule, turfgrass evapotranspiration was studied for three growing seasons. Stand density and color were also observed in an analysis of the amount of irrigation required to maintain the good appearance of grass in hot weather. For Nevada Blend lawngrass irrigation was necessary twice a week on sandy loam and once a week on loam soil. Weekly irrigation was sufficient for Tifway and Tifgreen burmadagrass on both loam and sandy loam soils. Water was applied to the test lysimeters at a rate of 2 surface inches (5.08 cm) per week. (Carr-Arizona)
W70-06003

SEASONAL PATTERNS IN EVAPOTRANSPIRATION BY IRRIGATED ALFALFA IN THE CENTRAL GREAT PLAINS,
Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.
Norman J. Rosenberg.
Agronomy Journal, Vol 16, No 6, p 879-886, November-December 1969. 6 fig, 3 tab, 2 append, 23 ref.

Descriptors: *Evapotranspiration, *Irrigation, *Environmental effects, *Alfalfa, *Great Plains, Nebraska, Semiarid climates, Lysimeters, Winds, Advection, Thermal radiation, Heat transfer, Humidity, Temperature, Air temperature, Soil temperature, Irrigation effects, Crop response, Nocturnal, Seasonal, Spring, Summer, Canopy, Radiation.
Identifiers: *Potential evapotranspiration, Canopy resistance, Net radiation, Temperature inversions.

The evapotranspiration regime of irrigated alfalfa grown in eastern Nebraska varies qualitatively and quantitatively with the season. Although low temperatures may induce strong canopy resistance resulting in less evapotranspiration, evapotranspiration may exceed net radiation in early spring. The recorded maximum for this season is about 6.5 mm day super -1. In late spring the evapotranspiration rates may go as high as 12 mm day super -1, probably due to low humidity and strong local and/or regional advection. Evapotranspiration declines as summer advances and by early August it seldom exceeds net radiation. Under the hot and humid summer conditions maximum evapotranspiration is approximately 7.5 mm day super -1. During the alfalfa growing season nocturnal evapotranspiration is also common and sometimes exceeds 1 mm per night. This is caused by strong temperature inversions which transfer sensible heat downward. During the experiment precision weighing lysimeters were used to determine evapotranspiration. (Carr-Arizona)
W70-06004

EVAPOTRANSPIRATION AND WATER STRESS OF BARLEY WITH INCREASED NITROGEN,
California Agricultural Experiment Station, Davis.
R. E. Luebs, and A. E. Laag.
Agronomy Journal, Vol 61, No 6, p 921-924, November-December 1969. 4 tab, 16 ref.

Descriptors: *Evapotranspiration, *Moisture stress, *Barley, *Nitrogen, *Crop production, Semiarid climates, Nitrates, Nitrogen compounds, Ammonium salts, Fertilizers, Grains (Crops), Crop response, Environmental effects, Consumptive use, Moisture uptake, Soil water, Soil moisture, Moisture availability, Turgidity, Leaves.
Identifiers: *Ammonium nitrate, Leaf area index.

An experiment was undertaken to determine if moderately heavy applications of nitrogen to nitrogen-deficient soil with limited water would cause water stress and depress grain yield. When nitrogen was applied at emergence in rates of 45 and 90 kg/ha, the leaf area index of barkey increased 44 and 109%, respectively, before stem elongation. Evapotranspiration was 14 and 43% higher, respectively, with the 45- and 90-kg rates in the period before and during tillering. During a 26-day dry period which followed, the barley crop with the highest leaf area index depleted the available soil water first. It also had the lowest relative leaf turgidity (52%) of the three test plots when the dry period ended. At this 90 kg/ha rate of nitrogen application, there was a 44% decrease in barley heads per unit land area and a 40% reduction in number of kernels per head. The result was a grain yield decrease of 1470 kg/ha. But at the 45-kg nitrogen application rate, yield increased by 450 kg/ha. This was undoubtedly due to having suffered less water stress than the high nitrogen plot. (Carr-Arizona)
W70-06006

SOIL WATER EVAPORATION AS AFFECTED BY WETTING METHODS AND CRUST FORMATION,
Agricultural Research Service, Fort Collins, Colo.; and Colorado State Univ., Fort Collins. Dept. of Soil Science.
E. Bresler, and W. D. Kemper.
Soil Science Society America Proceedings, Vol 34, No 1, p 3-8, January-February 1970. 6 p, 7 fig, 15 ref.

Descriptors: *Evaporation, *Irrigation, *Flooding, *Rainfall, *Saline soils, Simulated rainfall, Laboratory tests, Hydraulic conductivity, Infiltration, Salts, Soil dispersants, Soil treatment, Soil structure, Soil physical properties, Soil water movement.
Identifiers: Flow resistance (Soil water).

Laboratory studies showed that evaporation from soil columns which were wetted by flooding was 25-30% higher than soil wetted by rain and 30-40% higher than from soil to which NaCl was applied prior to wetting by simulated rain. About 25-35% more water evaporated from soil which was exposed to evaporation immediately following infiltration compared to soil which was exposed to evaporation 4 days after infiltration ceased. The crust which was formed at the soil surface by the raindrop action and dispersion due to sodium ion caused the wetting rate to decrease from 23 cm/hour in the flooded treatment to 1.1 in the rain and 0.06 cm/hour in the rain on NaCl treatment. Higher water content profile and shallower wetting zone resulted when rates of wetting were faster, and caused the total water loss to be higher. The total water loss was also affected by the type of crust which formed at the soil surface. (Knapp-USGS)
W70-06119

2E. Streamflow and Runoff

PATTERN OF POTENTIAL FLOW IN A FREE OVERFALL,
California Univ., Davis. Dept. of Water Science and Engineering; and Pahlavi Univ., Shiraz (Iran). Dept. of Engineering.
For primary bibliographic entry see Field 08B.
W70-05909

FRICTION FACTORS AND BED FORMS IN FLUVIAL CHANNELS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 02J.
W70-05911

FLOOD HAZARD INFORMATION, POTOMAC RIVER AND TRIBUTARY STREAMS, STAFFORD COUNTY, VIRGINIA.
Corps of Engineers, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W70-05918

FLOOD PLAIN INFORMATION, LATTAS AND SAN DIEGO CREEKS, ALICE, TEXAS.
Corps of Engineers, Galveston, Tex.
For primary bibliographic entry see Field 04A.
W70-05919

WATERSHED HYDRAULICS IN THE LABORATORY,
Missouri Univ., Rolla. Dept. of Civil Engineering.
Terence E. Harbaugh.
Available from the Clearinghouse as PB-191 212, $3.00 in paper copy, $0.65 in microfiche. Missouri University Water Resources Center Report, p 500-513, 1969. 13 p, 5 fig, 19 ref. OWRR Proj No B-007-MO.

Descriptors: *Rainfall-runoff relationships, *Hydrograph analysis, *Routing, Model studies, Mathematical models, Mathematical studies, Synthetic hydrology, Watersheds (Basins), Hydrogeology, Hydraulic models.
Identifiers: Watershed hydraulics.

Laboratory facilities are basic ingredients in the understanding of the hydromechanic behavior of natural watersheds. The significant variables which influence time of concentration, time to equilibrium, time to peak, lag time, etc., are readily observable, thus providing an insight into the hydromechanic behavior of watersheds. This paper is devoted to a discussion of the characteristics of the time distribution of runoff (hydrograph) with comments on lag time, time to peak, and other characteristic time responses of watersheds. Various definitions concerning the concept of time of concentration exist in hydrologic literature. The general definition, 'the time it takes a drop of water to travel from the uppermost part of the watershed to the outlet,' is shown to be in direct contradiction to the definition 'the time it takes a watershed to attain maximum discharge when subjected to a constant intensity rainfall.' (Knapp-USGS)
W70-05920

FLOOD PLAIN INFORMATION OF JACKSON RIVER, COVINGTON, CLIFTON FORGE AND ALLEGHANY COUNTY, VIRGINIA.
Corps of Engineers, Norfolk, Va.
For primary bibliographic entry see Field 04A.
W70-05923

RESULTS OF THE STUDY OF MACROTURBULENT MOVEMENT DOWNSTREAM OF A HYDRAULIC JUMP (IN FRENCH),
Institute of Hydrotechnical Research, Bucharest (Rumania). Hydraulics Section.
For primary bibliographic entry see Field 08B.
W70-05947

A METHOD OF DETERMINATION OF THE INTENSITY OF A STREAM MACROTURBULENCE THROUGH APPLICATION OF A THERMISTOR,
Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.
For primary bibliographic entry see Field 07B.
W70-05950

TURBULENCE CHARACTERISTICS MEASUREMENTS IN WATER FLOWS BEHIND GRIDS,
Moscow Inst. of Civil Engineering (USSR).
L. S. Givotovsky, N. V. Danilchenko, and V. S. Borovkov.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2

(Macroturbulence and stochastic processes in hydraulics), Paper B39, p 333-339, 1967. 7 p, 7 fig, 4 ref.

Descriptors: *Turbulent flow, *Turbulence, *Energy dissipation, *Model studies, Hydraulic models, Streamflow, Vortices, Eddies.
Identifiers: Isotropic turbulence, Turbulence decay.

Experimental data on the decay of isotropic turbulence in water flows are presented. Coincidence of experimental measurements and theoretical predictions was good. The turbulence intensity in water and air flows is similar. It is found that the turbulence intensity in water flow behind grids is proportional to the diameter of the rigid rods. The square of the velocity pulsation component is linearly dependent on the square of averaged velocity. (Knapp-USGS)
W70-05951

THE STEADY STATE AND DYNAMIC HEAT TRANSFER FROM TURBULENCE SENSORS IN LIQUIDS,
Purdue Univ., Lafayette, Ind.; and Tennessee Technological Univ., Cookeville.
For primary bibliographic entry see Field 07B.
W70-05952

THE EFFECT OF BEND ON THE DISTRIBUTION AND DEVELOPMENT OF THE MACROTURBULENCE INTENSITY IN OPEN CHANNEL BEDS,
Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05954

THE WATER RESOURCES OF CYPRUS -- THEIR CONSERVATION AND DEVELOPMENT,
Ministry of Agriculture and Natural Resources, Nicosia (Cyprus). Dept. of Water Development.
For primary bibliographic entry see Field 02F.
W70-05955

PROVISIONAL TIME-OF-TRAVEL FOR ILLINOIS STREAMS,
Illinois State Water Survey, Urbana.
John B. Stall, and Douglas W. Hiestand.
Available from the Clearinghouse as PB-189 701, $3.00 in paper copy, $0.65 in microfiche. Report of Investigation 63, 1969. 31 p, 3 tab, 9 fig, 8 ref. OWRR Project B-005-ILL.

Descriptors: *Streamflow, *Flow rates, Illinois, Streams, Water pollution sources, Flow measurement, River basins, Time series analysis.
Identifiers: *Dye tracers, Hydraulic geometry, *Time-of-travel.

Provisional estimates of the time-of-travel of a contaminant material in 41 reaches of principal streams in Illinois are presented in graphical form. Computed travel times for each stream reach are shown for high, medium, and low flow conditions, representing flow frequencies of 10, 50, and 90 percent of the days per year. Time-of-travel computations were based on equations for stream velocity developed in a previous study of the hydraulic geometry of streams for 18 river basins in Illinois. Computed times-of-travel are shown to be reasonably accurate by comparison with actual times-of-travel measured by dye tracers. The computed travel times are most reliable at high flows, becoming less so at diminishing flow rates. Advance information on the time-of-travel of materials in streams becomes highly important when the contaminant endangers downstream water users. Generalized results from this study will serve as useful estimates of travel time in streams until more direct and accurate measurements can be made.
W70-06035

EFFECT OF EROSION - CONTROL LAND TREATMENT ON FLOW FROM AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Washington, D.C.
Lloyd L. Harrold, and Frank J. Dragoun.
Trans. Amer. Soc. Agric. Engin. Vol 12, No 6, p 857-861, Nov-Dec 1969.

Descriptors: *Flow, *Water yield, *Land treatment, *Agricultural watersheds, *Erosion-control, Storm runoff, Terraces.
Identifiers: *Coshocton, Ohio; *Hastings, Nebraska; *Riesel, Texas; *Treynor, Iowa; Deep loess.

Farming methods that increased the area of grass and trees effectively reduced soil erosion and caused a reduction in annual surface water yield by about 30 percent in Ohio, Nebraska and Texas. Although level bench terraces in deep loess of western Iowa had little effect on total annual water yield, its stream flow came mostly from aquifers and was distributed fairly uniformly throughout the year. On unterraced watersheds much of the flow occurred as flashy storm surface runoff. These level terraces caused noticeable reduction in flood peak discharge rates. Major flood peaks in Ohio, Nebraska, and Texas were not affected by erosion-control land treatment. Watershed modeling techniques are not yet advanced to the point of predicting downstream effects on streamflow resulting from headwaters land use changes. (Harrold-USDA, ARS)
W70-06040

LONGITUDINAL DISPERSION OF THE LOWER KANSAS RIVER BASIN,
Kansas Water Resources Research Inst., Manhattan.
Yun-Sheng Yu, and Mahendra K. Bansal.
Available from the Clearinghouse as PB-191 249, $3.00 in paper copy, $0.65 in microfiche. Kansas Water Resources Research Institute, Contribution No. 37, 1970. 35 p, 20 fig, 9 ref. OWRR Project A-024-KAN.

Descriptors: *Dispersion, *Reynolds number, *Dye releases, Flow velocity, Missouri River, Mississippi River, Mixing, Tracers, Channel morphology, Turbulent flow, Uniform flow, Non-uniform flow, Alluvial channels, Open channel flow.
Identifiers: Lower Kansas River Basin, Lower Missouri River, Lower Mississippi River, Empirical equation, *Kansas River basin, Turbulent dispersion.

The field data of dye tests in the main stem reaches of the Lower Kansas River Basin, the Lower Missouri River from Yankton, South Dakota to Kansas City, Missouri, and the Lower Mississippi River from Baton Rouge to New Orleans, Louisiana have been analyzed to determine the dispersion coefficient for each of the study reaches. An empirical equation for the dye concentration distribution is obtained. From this empirical equation, a dispersion coefficient, which gives the best fit between the computed and the measured concentration-time curves, is selected as the nearly correct value of dispersion coefficient for the reach. The dispersion coefficient is then plotted in dimensionless form versus the Reynolds number based on the average flow velocity and average depth for the reach. The result shows that these two dimensionless parameters are linearly related on a log-log paper. (McKenna-Kansas State University)
W70-06096

SOME EXPERIMENTS WITH THE HOT-FILM ANEMOMETER IN WATER,
Queen's Univ., Belfast (North Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W70-06104

COMPUTATIONAL STUDY OF ACCELERATED FLOW IN A TWO-DIMENSIONAL CONDUIT EXPANSION,
Iowa Univ., Iowa City. Inst. of Hydraulic Research; and Carnegie-Mellon Univ., Pittsburgh, Pa. Biotechnology Program.
For primary bibliographic entry see Field 08B.
W70-06105

RESISTANCE STUDIES ON SMOOTH OPEN CHANNELS,
Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W70-06109

WORK-ENERGY EQUATION FOR THE STREAMLINE,
Iowa Univ., Iowa City. Coll. of Engineering.
Hunter Rouse.
ASCE Proceedings, Journal of Hydraulics Division, Vol 96, No HY5, Paper 7300, p 1179-1190, May 1970. 12 p, 4 fig, 11 ref, append.

Descriptors: *Hydraulics, *Turbulent flow, *Energy equation, Turbulence, Open channel flow, Head loss, Hydrodynamics, Boundary processes, Energy dissipation, Flow, Mathematical studies, Hydraulic jump.
Identifiers: Bernoulli theory.

The equation of energy for shear-free flow may be generalized through incorporation of the Saint-Venant terms for the work done by tangential as well as normal stresses. Although the resulting equation is conservative, a dissipative term may be introduced by substituting for the work done conservatively the difference between the total work and that done dissipatively. In the case of laminar flow, the usual Bernoulli terms for the streamline become augmented by two: one involving the energy transferred to (or work done upon) the neighboring fluid by viscous shear; and the other the viscous generation of heat. For the mean pattern of turbulent flow, the Reynolds stresses can be used to form two comparable terms; however, the dissipation term now represents the production of turbulence rather than the immediate generation of heat. Application of the equation is illustrated for three representative cases of fluid motion: two-dimensional Poiseuille flow; the boundary-layer wake of a flat plate; and the hydraulic jump. (Knapp-USGS)
W70-06112

RUNOFF AS AFFECTED BY SALT TREATMENTS AND SOIL TEXTURE,
Colorado State Univ., Fort Collins; and Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch.
W. D. Kemper, and L. Noonan.
Soil Science Society America Proceedings, Vol 34, No 1, p 126-130, January-February 1970. 5 p, 6 fig, 6 ref. OWRR Project B-008-COLO.

Descriptors: *Rainfall-runoff relationships, *Infiltration, *Soil cnemistry, *Soil treatment, Laboratory tests, Model studies, Simulated rainfall, Calcium sulfate, Sodium chloride, Soil sealants, Soil surfaces, Soils, Surface sealing, Permeability.
Identifiers: Permeability control (Soils).

Runoff was measured on soils during rains applied with a rainfall simulator in the laboratory. These soils were dried and rained on again and this sequence was repeated several times with runoff measured during each rain. The texture providing maximum runoff consisted of high sand contents (50 to 80%). Higher percentages of clay and silt resulted in surface cracking and considerable infiltration through those cracks. Marked increases occurred in runoff due to NaCL treatments and decreases occurred due to calcium sulfate treatments. Since the amounts of the salts required was small (244 to 896 kg/ha) and the cost of these salts is low (approximately $1.00/50 kg in bulk), emer-

gency water control of bare surfaces using salt treatments appears to be economically feasible. (Knapp-USGS)
W70-06114

FLOODS FROM SMALL DRAINAGE AREAS IN CALIFORNIA,
Geological Survey, Menlo Park, Calif. Water Resources Div.
For primary bibliographic entry see Field 04A.
W70-06142

FLOOD PLAIN INFORMATION, CROOKED CREEK AND TRIBUTARIES, CENTRALIA, ILLINOIS.
Corps of Engineers, St. Louis, Mo.
For primary bibliographic entry see Field 04A.
W70-06156

FREQUENCY OF FLOODS IN CITY OF LIVERPOOL,
New South Wales Univ., Kensington (Australia).
C. H. Munro, F. C. Bell, and D. N. Foster.
New South Wales University Water Research Laboratory Technical Report No 68/13, December 1968. 29 p, 10 fig, 12 ref, 1 append.

Descriptors: *Floods, *Flood forecasting, *Frequency analysis, Estimating, Data collections, Hydrologic data, Rainfall-runoff relationships, Unit hydrographs, Synthetic hydrology, Stage-discharge relations.
Identifiers: *Australia, *New South Wales, Flood frequency.

Estimates are made from rainfall records of the peak flood discharges of all major floods which have occurred in the period 1873-1968 inclusive in Liverpool, New South Wales, Australia. Historical evidence of flood peaks is reviewed for the period 1800-1872 inclusive. The recurrence intervals of floods equal to or greater than the 1956 flood is between 30 and 50 years, and the best estimate is 38 years. Estimates are made of the peak water level gradient down the river system from Liverpool Bridge to Milperra Bridge for floods of various magnitude. Peak floods of recurrence intervals of 10, 20 and 40 years. (Knapp-USGS)
W70-06162

STATISTICAL CHARACTERISTICS OF PRESSURE FLUCTUATIONS IN THE REGION OF HYDRAULIC JUMP,
Akademiya Nauk SSSR.
For primary bibliographic entry see Field 08B.
W70-06167

MACROTURBULENCE OF FLOWS BELOW SPILLWAYS OF MEDIUM HEAD DAMS AND THEIR PROTECTION AGAINST UNDERMINING,
Vsesoyuznyi Nauchno Issledovatelskii Institut Gidrotekhniki, Leningrad (USSR).
For primary bibliographic entry see Field 08B.
W70-06169

THE EFFECT OF MACROTURBULENCE IN THE TAILWATER OF TUBULAR SPILLWAYS ON TAILWATER STRUCTURES AND LOCAL SCOURING,
Kuybishev Civil Engineering Inst., Moscow (USSR).
For primary bibliographic entry see Field 08B.
W70-06170

ANALYSIS OF RANDOM PRESSURE FLUCTUATIONS IN STILLING BASINS,
Bureau of Reclamation, Denver, Colo. Div. of Research.
For primary bibliographic entry see Field 08B.
W70-06173

OPTICAL METHOD FOR EXPERIMENTAL STUDIES ON TURBULENT FLOWS,
Vsesoyuznyi Nauchno Issledovatelskii Institut Gidrotekhniki, Leningrad (USSR).
For primary bibliographic entry see Field 07B.
W70-06174

AREAL VARIATIONS OF BED-FORM CHARACTERISTICS IN MEANDERING STREAMS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Emmett M. O'Loughlin, and David Squarer.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B14, p 118-127, 1967. 10 p, 4 fig, 7 ref. OWRR Project A-020-IA.

Descriptors: *Turbulent flow, *Channel morphology, *Meanders, *Alluvial channels, Statistical methods, Sand waves, Dunes, Scour, Regime, Flow, Time series analysis, Open channel flow, Vortices, Model studies, Hydraulic models.
Identifiers: *Secondary currents, Macroturbulence.

The reliability of expressions for resistance coefficients and sediment discharge in alluvial channels is open to question when they are applied to sinuous channels because no account is taken of the distorted channel section and the secondary currents induced by channel curvature. Bed-form geometry is related in a fundamental way to resistance and sediment discharge, and it is shown in this paper that channel curvature results in significant variations in bed-form geometry. Following a procedure similar to that described by Nordin and Algert, autocovariance and spectral density functions of a process defined by the bed elevation as a function of the distance along the channel are computed in several zones in a laboratory model of an alluvial channel having an equilibrium bed configuration. These data are compared with other data of the same type obtained with nominally identical flow conditions (same mean depth and mean velocity) and bed material in a straight flume. Details of spectrum computations are discussed in terms of the length of record and the variability of the estimated spectral density. Stationarity requirements indicate that future analyses should probably be made in the time domain, and in such cases the possibility of relating time and space spectra needs close examination. (Knapp-USGS)
W70-06176

THE GEORGES RIVER HYDRAULIC, HYDROLOGIC AND RECLAMATION STUDIES,
New South Wales Univ., Kingston (Australia).
For primary bibliographic entry see Field 02L.
W70-06177

FRESHWATER FISHES OF CONNECTICUT,
Connecticut Univ., Storrs.
Walter R. Whitworth, Peter L. Berrien, and Walter T. Keller.
State Geological and Natural History Survey of Connecticut, Bulletin 101, 1968. 134 p. 48 fig, 7 tab, 100 ref.

Descriptors: *Fish, *Freshwater fish, *Fish taxonomy, Populations, Fish populations, Aquatic environment, Life history studies, Distribution, Connecticut, Surveys.
Identifiers: Taxonomic keys, Systematic biology.

Identification, distributional records and generalized life histories are given for 82 species among 53 genera belonging to 26 families of freshwater fishes. Freshwaters are defined as inland waters and waters entering the sea that are not included in the zone invaded by tidal movements. Collections were made at approximately 750 sampling areas; collection records were augmented by museum collections and field records of previous workers. Records were made of selected physical and chemical characteristics of the collection sites; these include stream size, gradient, bottom type, turbidity, total alkalinity, and hardness. Collection of fish species are listed in terms of these characteristics in a series of four tables. A glossary and index of common and scientific names are included. (Voigtlander-Wisconsin)
W70-06236

2F. Groundwater

HYDRAULICS OF AQUIFERS AT ALAPAHA, COOLIDGE, FITZGERALD, MONTEZUMA, AND THOMASVILLE, GEORGIA,
Georgia State Geological Survey, Atlanta.
Charles W. Sever.
Georgia Geological Survey Information Circular 36, 1969. 16 p, 13 fig, 4 tab, 16 ref.

Descriptors: *Hydrogeology, *Aquifers, *Georgia, Transmissivity, Storage coefficient, Borehole geophysics, Cores, Drawdown, Water yield, Water wells, Data collections, Hydrologic data.
Identifiers: Aquifer testing, Well interference.

The results of aquifer performance tests made on four well fields tapping limestones of Miocene, Oligocene, or Eocene age show that the hydraulic properties vary greatly from one limestone aquifer to another in southwestern Georgia. Coefficients of transmissibility in the limestones ranged from 120,000 gpd per ft (gallons per day per foot) at Fitzgerald, Ga., to perhaps as much as 20,000,000 gpd per ft at Thomasville, Ga. The coefficient of storage ranged from 0.00002 to 0.003. An aquifer performance test made on sand aquifers of Cretaceous age near Montezuma, Ga., shows the coefficient of transmissibility to be about 60,000 gpd per ft and the coefficient of storage to be about 0.002. The geophysical and lithologic logs and the drawdown versus distance graphs made for the well fields described in this report should enable prediction of the amount of interference between wells and also aid in determining the proper construction and spacing of wells. (Knapp-USGS)
W70-05924

THERMAL WATERS OF SWAZILAND,
D. R. Hunter.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 165-170, 1969. 6 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Thermal waters, Mineral waters, *Springs, *Aquifers, *Groundwater, Water temperature, Water chemistry, Water utilization, Discharge (Water), Mapping, Geology, Gases, Sodium, Sulfates, Carbonates, Calcium, Trace elements, Silica, Carbon dioxide, Nitrogen.
Identifiers: *Swaziland.

Eight thermal springs with temperatures ranging from 33 to 53 deg C are known in Swaziland. Their yields are 72 to 455 cu m per 24 hours. All the springs are associated with granitic rocks of Precambrian age, often adjacent to fault or joint systems. Na, Cl, sulfate, carbonate, bicarbonate, silicic acids, nitrogen, oxygen, helium, and some argon are present in considerable amounts in the waters of these springs. (Gabriel-USGS)
W70-05926

THE THERMAL WATERS IN THE REPUBLIC OF SOUTH AFRICA,
L. E. Kent.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 143-164, 1969. 22 p, 3 fig, 3 tab, 13 ref.

Descriptors: *Thermal waters, *Mineral waters, *Springs, *Aquifers, *Groundwater, *Water tem-

perature, Boreholes, Water chemistry, Discharge (Water), Mapping, Water sources, Geology, Fissures (Geology), Water utilization, Gases, Salinity, Trace elements.
Identifiers: *Republic of South Africa.

There are 87 thermal springs and groups of springs and boreholes that discharge thermal water, assumed to be over 25 deg C, in the Republic of South Africa. The temperature of the springs ranges from 25 to 59.9 deg C. The springs are associated with faulted areas and with relatively high annual rainfalls. The thermal waters of South Africa can be subdivided into the 5 groups as follows: highly mineralized chloride-sulfate waters; moderately saline waters; temporary hard carbonate waters; alkaline sodium bicarbonate and carbonate waters; and pure or undifferentiated waters with total dissolved substances less than 0.2 g/l. The majority of thermal springs and boreholes are utilized for therapeutic purposes. (Gabriel-USGS)
W70-05927

THERMAL AND THERMO-MINERAL SPRINGS OF THE DEMOCRATIC REPUBLIC OF CONGO (IN FRENCH),
A. LeBail, and M. Buchstein.
In: Preceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 87-104, 1969. 18 p, 6 fig, 2 tab, 6 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Mapping, Geology, Structural geology, Lakes, Fissures (Geology), Water sources, Water temperature, Water chemistry, Discharge (Water), Gases, Water utilization, Trace elements.
Identifiers: *Congo Democratic Republic.

Geology and distribution of thermal and mineral springs in the Katanga and Kivu-Kibali-Ituri provinces of the Congo are discussed. Temperature, discharge, and principal mineral components of the springs in 66 areas of Katanga and 44 of Kivu-Kibali-Ituri are tabulated. The temperature of spring waters ranges from 28 to 100 deg C and the principal mineral components consist of Na Cl, Ca, K, Na, Mg, Fe, carbonate, sulfate, Hydrogen sulfide, Cl, carbon dioxide and silica. The travertine deposits of the Katanga thermal-waters are utilized for the manufacture of cement, and several springs are utilized by local population for the production of salt. (Gabriel-USGS)
W70-05928

MINERAL AND THERMAL WATERS OF CEYLON,
J. P. R. Fonseka, N. R. De Silva, V. S. Balendran, and L. K. Seneviratne.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the Worlk, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 9-19, 1969. 11 p, 7 fig, 2 tab, 6 ref.

Descriptors: *Mineral water, *Thermal water, Aquifers, *Groundwater, *Springs, Geology, Radioactivity, Coastal plains, Water temperature, Discharge (Water), Water chemistry, Mapping, Carbon dioxide, Carbonates, Sulfates, Silica, Calcium, Magnesium, Sodium, Potassium.
Identifiers: *Ceylon.

At present there are nine thermal and mineral springs in Ceylon. Many of the springs are in heavy jungle and marshy land where the underlying Precambrian bedrock, is poorly exposed. The springs do not appear to have a direct association with radioactivity or recent volcanicity. The water temperature varies from 34 to 55 deg C. The spring waters contain from 0.220 to 0.990 g/l of mineral matter. Many of the springs are characterized by their relatively large contents of free carbon dioxide, Cl, Sulfate, Silica, Ca, Na, and K. (Gabriel-USGS)
W70-05929

QUANTITATIVE INTERPRETATION OF REGIONAL GROUNDWATER FLOW PATTERNS AS AN AID TO WATER BALANCE STUDIES,
Department of Energy, Mines and Resources, Calgary (Alberta).
R. Allan Freeze.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 154-173, 1968. 20 p, 6 fig, 5 tab, 10 ref.

Descriptors: *Groundwater movement, *Water balance, Steady flow, Simulation analysis, Mathematical models, Groundwater basins, Lakes, Mapping, Piezometers, Subsurface flow, Surface runoff.
Identifiers: *Canada, Saskatchewan, Good Spirit Lake.

The simulation of steady-state regional groundwater flow patterns in a three-dimensional, nonhomogeneous, anistropic groundwater basin is possible by obtaining solutions to an appropriate mathematical model. The groundwater flow patterns determined by a mathematical model analysis of the Good Spirit Lake drainage basin in east-central Saskatchewan, Canada are confirmed by field mapping of discharge phenomena and by piezometer measurements. The natural basin yield compared well with the available measurements and estimates of the other components of the water balance. A method is presented to determine the average annual groundwater component of surface runoff and average annual subsurface outflow. (Carstea-USGS)
W70-05932

THE GROUNDWATER BALANCE VARIATION IN THE EXPLORATION AND DEVELOPMENT OF ARTESIAN BASINS,
P. F. Kvartskhava.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 198-206, 1968. 9 p, 4 fig.

Descriptors: *Artesian wells, *Groundwater recharge, Wells, Aquifers, Analytical techniques, Exploration, Water yield.
Identifiers: *Groundwater balance, *Aquifer depletion, Maximum yield.

Groundwater balance of artesian basins is discussed for natural conditions and normal hydraulic and potential regimes in recharge areas. Changes in water balance of an artesian basin by a number (n) of wells, and the recovery of water balance without aquifer depletion are described. Methods are presented for determining the beginning of the depletion for artesian aquifers. Techniques are given for determining the maximum total yield of artesian wells without depletion of aquifers. (Carstea-USGS)
W70-05935

ANALYSIS OF THE GROUNDWATER HYDROGRAPH,
Josef Hofbauer.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 219-238, 1968. 20 p, 15 fig.

Descriptors: *Hydrograph analysis, *Hydrographs, Statistical methods, Hydrologic data, Reservoirs, Water storage, Aquifers, Gaging stations, Water level fluctuations.
Identifiers: Groundwater hydrographs.

Statistical methods were used to evaluate hydrologic data from about 500 stations measuring the groundwater storage reservoirs of Bavaria. The period of observation was roughly 20-30 years. The data collected from 5 connected and interrelated groundwater basins are also interpreted and graphically presented. In 1962, attempts were made to select representative gaging stations whose monthly mean hydrographs would approximate the mean value of a great number of similarly located gaging stations. The statistical selection of gaging stations may be of considerable importance for engineering purposes. (Carstea-USGS)
W70-05936

THE THERMOMETRICAL METHODS OF STUDYING GROUNDWATER,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
N. M. Frolov.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 269-283, 1968. 15 p, 7 fig, 3 tab, 6 ref.

Descriptors: *Thermal properties, *Groundwater movement, *Groundwater recharge, Energy, Radioactivity effects, Uranium radioisotopes, Heat flow, Thermal water, Leakage, Karst.
Identifiers: *Thermal regime, Endogenous energy source, Exogenous energy source, Thorium.

Endogenous and exogenous energy sources are responsible for the thermal regime of the earth. The first group refers to heat generated from radioactive decay of uranium, thorium, and potassium, whereas the second source covers mostly from the sun. Groundwater is characterized by a high heat capacity and mobility. Thermometric methods for studying groundwater are based on heat and mass processes in the rock-water system. Knowledge of the hydrogeothermal regime is of prime importance in studying thermal waters. Hydrogeothermal methods are useful in solving some of the following problems related to groundwater: (1) hydrodynamic problems (movement, recharge, leakage, etc.); (2) estimation of the heat quantity transported by the groundwater from the earth's interior; (3) thickness and intensity of karst development; and (4) interaction of ground and surface waters, and other problems. Examples of these studies are discussed. (Carstea-USGS)
W70-05938

DARCY'S LAW DURING UNSTEADY FLOW,
Cincinnati Univ., Ohio. Dept. of Civil Engineering.
Louis M. Laushey, and Laxmidas V. Popat.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 284-299, 1968. 16 p, 8 fig, 2 tab, 10 ref.

Descriptors: *Darcy's law, *Steady flow, *Unsteady flow, Flow rates, Permeability, Piezometers, Reynolds number, Laminar flow, Water table, Mathematical studies, Groundwater movement.

Many steady flow test were performed over a wide range of flow rates to extend the range of validity of Darcy's law. The experimental conditions were selected in such a way that: (1) permeability was not a variable; (2) the piezometric slope was essentially constant along the tube during each test; (3) the piezometric gradient was proportional to the flow rate; (4) the maximum flow rate was at least equal to that measured during the unsteady tests; and (5) the Reynolds number was smaller than unity. Experiments with unsteady laminar flow showed that Darcy's law was incomplete unless the total derivative of the water table elevation with both distance and time was used for the gradient of the static head. A theory for unsteady flow is presented. (Carstea-USGS)
W70-05939

ARTIFICIAL RECHARGE THROUGH INJECTION WELLS IN A SANDSTONE AQUIFER,
Nebraska Univ., Lincoln.
For primary bibliographic entry see Field 04B.
W70-05940

EFFECT OF TOPOGRAPHY ON GROUNDWATER FLOW,
California Univ., Berkeley. Dept. of Civil Engineering.
M. Shahbazi, S. Zand, and D. K. Todd.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 314-319, 1968. 6 p, 4 fig, 1 tab, 6 ref.

Descriptors: *Topography, *Groundwater movement, Steady flow, Groundwater recharge, Mathematical models, Water table, Digital computers, Aquifers.
Identifiers: Hele-Shaw models.

Steady state flow patterns of groundwater in two dimensions for an unconfined homogeneous and istropic aquifer were determined for various ground surface configurations and recharge rates. Data were obtained from a Hele-Shaw viscous fluid model and from a mathematical model with solutions obtained by employing a digital computer. Results by the two methods were compared and also with work of previous investigators. It was found that the location and elevation of low points of the ground surface configuration and the rate of recharge had a marked effect on the shape of the water table; furthermore, the areas of recharge to and discharge from the water table varied with the above parameters. (Carstea-USGS)
W70-05942

THE FONTAINE DE VAUCLUSE (IN FRENCH),
Bordeaux Univ. (France). Dept. of Hydrogeology.
Henri Schoeller, and Michel Aigrot.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Assembly of Scientific Hydrology, Publication No 77, p 320-328, 1968. 9 p, 3 fig, 4 tab, 8 ref.

Descriptors: *Groundwater movement, *Aquifers, *Springs, *Karst, Porosity, Permeability, Hydrodynamics.
Identifiers: *France, Vaucluse.

The springflow hydrodynamics may be better understood by study of the Fontaine de Vaucluse. In the aquifer supplying the spring, the porosity is 25 times and the permeability 5 times greater above the groundwater level than below it. This shows the presence of large karst cavities above the groundwater level. (Carstea-USGS)
W70-05943

NONSTEADY TWO-LAYER RADIAL FLOW TO WELLS,
Indiana Univ., Bloomington. Dept. of Geology.
For primary bibliographic entry see Field 04B.
W70-05944

RHEOELECTRIC ANALOGY; STUDY OF AN ARTESIAN BASIN, APPLICATION ON THE ARTESIAN GROUNDWATER OF THE 'SABLES INFERIEURS D'AQUITAINE' (IN FRENCH),
Bordeaux Univ. (France). Dept. of Hydrogeology.
A. Cazal, Y. Emsellem, B. Moussie, P. Pouchan, and H. Schoeller.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 343-352, 1968. 10 p, 7 fig, 6 ref.

Descriptors: *Analog models, *Groundwater movement, Artesian wells, Model studies, Sands, Transmissivity, Observation wells, Unsteady flow.
Identifiers: *France, Aquitaine.

Rheoelectric models are useful tools for studying groundwater movement, particularly with boundary conditions, transmissivity and possibilities of water utilization. An analog model was used to show water movement in the lower sands of Aquitaine, France. The water depth in this sandy formation of Eocene age ranged between 150 and 400 meters. The transmissivity and potential data were obtained by numerous observation wells. These data were then used to build the analog model, which can be developed for solving problems related to unsteady flow. (Carstea-USGS)
W70-05945

ON THE TECHNIQUE FOR SOLVING HYDROGEOLOGICAL PROBLEMS USING SOLID AND NETWORK ELECTRIC MODELS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
V. M. Shestakov.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 353-360, 1968. 8 p, 2 fig, 12 ref.

Descriptors: *Analog models, *Model studies, *Groundwater movement, Unsteady flow, Fresh water, Saline water, Saline water-freshwater interfaces, Density, Seepage, Free surfaces.
Identifiers: Two-dimensional flow.

Many important problems in hydrology can be solved by the use of analog models. Simulation of two-dimensional flow for unsteady unconfined flow and saline water fresh water interfaces are discussed. The method of gradients is commonly used in simulating unsteady seepage for free-surface flows. The difference in densities between saline and fresh waters is very important. The rate of displacement of the interface during the calculated interval of time is determined by a graphical addition of actual seepage rates on the axes corresponding to the network direction. (Carstea-USGS)
W70-05946

THE WATER RESOURCES OF CYPRUS -- THEIR CONSERVATION AND DEVELOPMENT,
Ministry of Agriculture and Natural Resources, Nicosia (Cyprus). Dept. of Water Development.
C. A. C. Konteatis.
Nicosia, Cyprus, 'GEKA' Printing Enterprises, January 1967. 58 p, 10 fig, 8 photo, 9 tab, 29 ref.

Descriptors: *Water resources, *Water resources development, Surface waters, Groundwater, Reservoirs, Water law, Water rights, Topography, Climates, Water balance, Water supply, Irrigation water, Municipal water, Aquifers, Streamflow, Geology, Hydrogeology.
Identifiers: *Cyprus.

The topography, geology, and water resources of Cyprus are described and plans for the island's water resources development are outlined. The physical and climatic features of the island which control the available water resources, land resources, and crop patterns are outlined. A table shows a tentative water balance. Domestic water supplies both for rural and town needs and the future possibilities for supplementing these water supplies are described. Irrigation and other water conservation projects include groundwater recharge, river training, drainage, flood control and desalination works. Tables show the utilization of the water resources, the type of crops, the quantity of water extracted and the actual irrigation efficiency. Institutional, legal, economic and financial aspects, water laws, and the present policy on economic analyses of projects are described. The last chapter describes the prospects for future development including both the natural water resources and artificial methods for increasing water resources such as artificial rainfall, evaporation control, sewage water recovery and desalination. Tables show the water use in every hydrological catchment, the available and surplus water resources, and possible future irrigation which could be achieved from the available surplus. A diagram indicates the utilization of the water resources in the past few years, the projected possible utilization, and economic growth from irrigation. (Knapp-USGS)
W70-05955

NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Geological Survey, Washington, D.C. Water Resources Div.
Istavros S. Papadopulos.
Journal of Geophysical Research, Vol 71, No 20, p 4791-4797, October 15, 1966. 7 p, 2 fig, 22 ref.

Descriptors: *Groundwater movement, *Mathematical studies, Flow, Porous media, Hydraulics, Darcys law, Permeability, Aquifers, Unsteady flow, Non-uniform flow, Porosity, Transmissivity, Drawdown, Water level fluctuations.
Identifiers: Multiaquifer wells.

The nonsteady flow toward a well open to two aquifers of different hydraulic properties is analyzed. Exact solutions to the problem are found to be intractable for numerical calculations. Therefore, asymptotic solutions which are amenable to easy computation and which yield results accurate enough for practical applications are developed. These solutions make possible the prediction of pumping levels and yields of two-aquifer wells. They also provide a basis for predicting the hydraulic head changes around such wells and the contribution of each aquifer to the total discharge of the well. (Knapp-USGS)
W70-05956

APPLICATION OF ELECTRIC WELL LOGGING AND OTHER WELL LOGGING METHODS IN HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
Chester Lao, Frank L. Peterson, and Doak C. Cox.
Technical Report No. 21, November 1969. 108 p, 4 tab, 16 fig, 49 ref, 5 append.

Descriptors: Groundwater, *Electrical well logging, *Geophysical well logging, *Porosity, *Well yield.

A comprehensive study of electric well logging and other geophysical well logging techniques in Hawaii has resulted in much basic geologic, hydrologic and geometric information from wells in Hawaiian basaltic aquifers. The functions logged include spontaneous potential, point resistivity, short and long normal resistivity, lateral resistivity, water temperature, water conductivity, and caliper. Formation resistivity and fluid conductivity in particular produced much important qualitative and quantitative information.
W70-06098

CAVE FEATURES: INFORMATION CONCERNING THE NATURE AND GENESIS OF SOILS,
Maryland Univ., College Park. Dept. of Agronomy.
For primary bibliographic entry see Field 02G.
W70-06115

DIGITAL MODEL OF ALLUVIAL AQUIFER,
Nova Scotia Dept. of Mines, Halifax; and Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 06A.
W70-06130

A SUMMARY OF MINERAL AND THERMAL WATERS IN AUSTRALIA,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
I. R. McLeod.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 289-292, 1969. 4 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Mineral water, *Thermal water, *Springs, *Aquifers, *Groundwater, Geology, Water temperature, Water chemistry, Chemical analysis, Water utilization, Mapping, Discharge (Water), Brines, Calcium, Magnesium, Sodium, Chlorine, Sulfates, Trace elements, Boreholes.
Identifiers: *Australia.

Some hydrological and chemical data of the Lake Eyre mound springs and of three other Australian hot springs are presented. The water in the known thermal springs is groundwater heated by circulation to deep layers. K, Na, Mg, Ca sulfate, carbonate, and Cl, are the main mineral constituents of these waters. The springs of Australia are utilized on a very small scale, although the iron ore of springs located near Mittagong, New South Wales, is mined on a relatively large scale. Underground brine is tapped and evaporated to produce common salt at Port Alma. (Gabriel-USGS)
W70-06145

LAND SUBSIDENCE DUE TO THE APPLICATION OF WATER,
Geological Survey, Sacramento, Calif.
For primary bibliographic entry see Field 08D.
W70-06150

THE MINERAL AND THERMAL WATERS OF THE TERRITORY OF PAPUA AND NEW GUINEA,
Bureau of Mineral Resources, Geology, and Geophysics, Canberra (Australia).
R. F. Heming.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 293-304, 1969. 12 p, 1 fig, 2 tab, 14 ref.

Descriptors: *Mineral waters, *Thermal waters, *Springs, *Aquifers, *Groundwater, Geology, Volcanoes, Mapping, Heat flow, Water temperature, Water chemistry, Chemical analysis, Water utilization, Discharge (Water).
Identifiers: *Papua, *New Guinea.

Thermal areas in Papua and New Guinea are related to volcanism or result from heat flows. The water temperature of the springs ranges from 20 to 100 deg C, and Ca, Na, K, Mg, Al, Fe, carbonate, silica, Cl, and sulfate are the main mineral constituents of their waters. Many of the thermal springs are utilized for cooking and bathing purposes. (Gabriel-USGS)
W70-06151

SPRINGS OF DEEP SEATED ORIGIN IN TANZANIA,
B. G. Walker.
Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 171-180, 1969. 10 p, 1 fig, 1 tab, 11 ref.

Descriptors: *Springs, *Aquifers, *Groundwater, *Thermal water, *Mineral water, *Water sources, Water temperature, Water chemistry, Water supply, Water utilization, Discharge (Water), Geology, Mapping, Sodium, Carbonates, Sulfates, Chlorides, Calcium, Magnesium, Silica, Potassium.
Identifiers: *Tanzania.

Numerous springs in Tanzania are associated with rift valleys and faulted blocks of the rift systems. Chemical composition, temperature, discharge, and related geological features of the deep-seated springs of the region are tabulated. The temperature of spring waters ranges from 14 to over 37 deg C, and they contain some Na, K, Ca, Mg, Carbonate, Bicarbonate, Sulfate, Silica, and small amounts of CO, methane, He, and Ar. Several springs contain considerable gases, including N, carbon dioxide, and He. The brine springs at Uvinza and Ivuna are utilized for the production of salt. (Gabriel-USGS)
W70-06152

FLOW THROUGH POROUS MEDIA,
Princeton Univ., N.J.
Roger J. M. De Wiest.
New York, Academic Press, Inc, 1969. 530 p.

Descriptors: *Groundwater movement, *Flow, *Porous media, Darcys law, Porosity, Permeability, Hydraulic conductivity, Hydrodynamics, Dispersion, Unsaturated flow, Soil water movement, Saturated flow, Water table, Aquifers, Storage coefficient, Artesian wells, Mathematical models, Hydraulic models, Mathematical studies, Analog models, Bibliographies.
Identifiers: Confined aquifers, Green's functions, Immiscible fluid flow.

This book deals with the flow of fluids, especially water, through the upper layers of the earth. Topics covered include the theory of groundwater flow and storage, dispersion, unsaturated and unsteady flow, and other aspects of flow through porous media. Although some sections require a solid grasp of mathematical physics, this research-level study will appeal to all civil, petroleum, and geological engineers, and to all hydrologists. Research workers and graduate students in hydrology will find this volume a valuable up-to-date reference to contemporary developments in their field. Each of the 11 chapters is well referenced. The book has a total of 536 references; the chapter on flow of water in unsaturated soils has 244 referenced items. (Knapp-USGS)
W70-06154

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF BAKER COUNTY, FLORIDA,
Geological Survey, Jacksonville, Fla.
Gilbert W. Leve.
Florida Division of Geology Report of Investigations No 52, 1968. 24 p, 9 fig, 3 tab, 9 ref.

Descriptors: *Groundwater, *Aquifers, *Hydrogeology, *Florida, Borehole geophysics, Groundwater movement, Recharge, Potentiometric level, Water quality, Water yield, Water wells, Deep wells, Subsurface mapping, Water levels, Water utilization.
Identifiers: Baker County (Florida), Floridan aquifer, Duval County (Florida), Jacksonville.

Test drilling, borehole geophysical methods and an inventory of wells were used to obtain data on the groundwater resources of Baker County, Florida. Water supplies are obtained from three aquifers: (1) the water-table aquifer, (2) the shallow artesian aquifer, and (3) the Floridan aquifer. The Floridan aquifer, which is the greatest potential source of water, is composed of limestones of Tertiary age. It underlies all of Baker County at elevations ranging from less than 50 to more than 350 feet below sea level and is 750 to 1,000 feet thick. The water contains between 121 to 204 mg/liter carbonate hardness and 141 to 217 mg/liter dissolved solids. Potentiometric maps indicate that water probably recharges the aquifer within southern Baker County and moves radially away towards discharge areas. Some of this water moves into adjacent Duval and Nassau Counties, Florida and is discharged by numerous industrial and municipal wells. A progressive decline of the potentiometric surface of the aquifer in Baker County of 10 to 20 feet between 1945 and 1964 is related to increased discharge by wells in Jacksonville and Fernandina. (Leve-USGS)
W70-06163

GEOLOGY AND HYDROLOGY OF THE MARTINSBURG FORMATION IN DAUPHIN COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, Pa.; and Pennsylvania State Geological Survey, Harrisburg.
Louis D. Carswell, Jerrald R. Hollowell, and Lucian B. Platt.
Pennsylvania Geological Survey Groundwater Report W24, 1968. 54 p, 17 fig, 1 plate, 3 tab, 34 ref.

Descriptors: *Water resources, *Geology, *Groundwater, *Pennsylvania, Aquifers, Water wells, Water yield, Water supply, Drawdown, Specific yield, Transmissivity, Shales, Limestones, Water quality.
Identifiers: Dauphin County (Penn), Martinsburg Formation.

The Martinsburg Formation in Dauphin County, Pennsylvania, consists of shale, siltstone, sandstone, conglomerate, limestone, chert, and cherty mudstone. Groundwater occurs in the Martinsburg in secondary openings along joints, faults, and cleavage and bedding planes. The secondary openings are well developed near the surface and become progressively tighter as the depth increases. Borehole-velocity measurements and drilling data indicate that the circulation of groundwater is limited to the upper few hundred feet of strata. Groundwater is generally adequate for domestic use throughout the County. Specific capacities of domestic wells averaged 0.15 gpm per ft and ranged from 0.01 to 1.5 gpm per ft. The specific capacities of wells drilled to obtain the maximum available yield averaged 1.0 gpm per ft and ranged from 0.02 to 7.0 gmp per ft. Few wells drilled to obtain the maximum amount of water available yielded more than 100 gpm and none yielded more than 200 gpm; the average yield of these wells was about 50 gpm. Urbanization in Dauphin County has changed the flow regimen of Paxton Creek. As a result, the base flow of Paxton Creek in 1963, was sustained 26,000 gpd over normal. Groundwater in the Martinsburg Formation is of the calcium bicarbonate type. Contamination is restricted to local areas of concentrated housing and to areas underlain by limestone. (Knapp-USGS)
W70-06165

2G. Water in Soils

INFILTRATION ANALYSIS I-INTRODUCTION,
C. Toebes.
New Zealand Handbook of Hydrological Procedures, Procedure No 21, Ministry of Works, Wellington, 1969. 13 p, 13 fig, 3 tab, 7 ref.

Descriptors: *Infiltration, *Surface-groundwater relationships, *Groundwater movement, Water balance, Analytical techniques, Hydrograph analysis, Hydrographs, Water levels, Water level fluctuations.
Identifiers: Infiltration capacity.

Infiltration analysis may be carried out using rainfall and runoff data from sprinkling plots, from runoff plots, or from small natural basins. It determines the variation of infiltration with time for the duration of a storm. The variation of infiltration with time is expressed by a curve; either an infiltration-rate curve showing the variation of the rate of infiltration with time, or an infiltration-mass curve showing the variation of the mass infiltration with time. If the rainfall intensity during the storm is a rate greater than the infiltration capacity, the rate-of-infiltration curve is called the infiltration-capacity curve. (Knapp-USGS)
W70-05916

MODELLING OF INFILTRATION PROCESS IN THE ANALOG COMPUTER,
Gidrometeorologicheskii Institut, Odessa (USSR).
E. V. Terentjev.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 309-313, 1968. 5 p, 1 fig, 5 ref.

Descriptors: *Analog models, *Infiltration, *Model studies, Mathematical studies, Equations, Storm runoff, Irrigation, Computers, Economics.
Identifiers: *USSR, South Ukraine.

The differential equation proposed and applied for isotropic soil by G. A. Alekseev serves as a basis for an analog model of the infiltration process. The infiltration model results were compared to studies of storm runoff losses by means of overhead irrigation of soils in the South Ukraine. The use of a low cost universal analog computer in combination with the possibility of an easy and rapid change of the factors of the differential equation makes possible the analysis of a great number of variables at a relatively low cost. A scheme for solving the differential equation is shown and discussed. (Carstea-USGS)

W70-05941

THE CHEMICAL NATURE OF THE ORGANIC MATRIX BELIEVED TO LIMIT WATER PENETRATION IN GRANITIC SOILS,
Nevada Bureau of Mines, Reno. Desert Research Inst.
R. J. Morris, and Michael Natalino.
Available from the Clearinghouse as PB-191 213, $3.00 in paper copy, $0.65 in microfiche. Desert Research Institute Project Report No 13, Nevada University, July 1969. 13 p, 4 fig, 2 chart, 3 tab, 9 ref. OWRR Project A-025-NEV.

Descriptors: *Soil chemistry, *Organic matter, *Infiltration, *Wettability, Percolation, Permeability, Soil chemical properties, Soil physical properties, Surface tension, Wetting.
Identifiers: *Non-wettable soils.

Accumulated organic material from forest litter thought to limit water penetration in granitic soils was identified. A marked decrease in rate of soil wettability and water penetration occurs following forest fires. This effect was simulated under laboratory conditions by firing soils treated with extracts of the representative ground cover composed of pine, snowbush, and manzanita species. Infrared studies of the alcoholic extracts from dried concentrates indicated the definite presence of polymeric carboxylic acids. (Knapp-USGS)
W70-05957

NO-TILLAGE CORN - CHARACTERISTICS OF THE SYSTEM,
Agricultural Research Service, Washington, D.C.
For primary bibliographic entry see Field 03F.
W70-06039

TRANSLOCATION OF HYDROPHOBIC SUBSTANCES INTO SOIL BY BURNING ORGANIC LITTER,
Forest Service (USDA), Glendora, Calif. Pacific Southwest Forest and Range Experiment Station; and California Univ., Riverside.
L. F. DeBano, L. D. Mann, and D. A. Hamilton.
Soil Science Society America Proceedings, Vol 34, No 1, p 130-133, January-February 1970. 4 p, 3 fig, 2 tab, 8 ref.

Descriptors: *Wettability, *Soil physical properties, *Burning, *Organic matter, Wetting, Permeability, Soil properties, Sands, Soils, Soil chemistry, Soil water movement, Infiltration.
Identifiers: *Water repellent soils.

Unknown hydrophobic substances were vaporized in surface layers of litter and water repellent soil by an imposed heat treatment. The vaporized substances moved downward and condensed in different test soils where they produced a water repellent layer. The thickness of the water repellent layer in the underlying test soil increased as percent silt and clay decreased. The thickest and most intensely water repellent layer was produced in a uniform 35-mesh sand. The effect of texture on water repellency was attributed to large differences in specific surfaces of the soils which ranged from 0.0077 to 55 sq m/g. The induced water repellency was not directly related to a given amount of organic matter translocated by the heat treatment. Generally, however, the degree of water repellency increased as the amount of translocated organic matter increased in given test soil. (Knapp-USGS)
W70-06113

RUNOFF AS AFFECTED BY SALT TREATMENTS AND SOIL TEXTURE,
Colorado State Univ., Fort Collins; and Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch.
For primary bibliographic entry see Field 02E.
W70-06114

CAVE FEATURES: INFORMATION CONCERNING THE NATURE AND GENESIS OF SOILS,
Maryland Univ., College Park. Dept. of Agronomy.
D. S. Fanning.
Soil Science Society America Proceedings, Vol 34, No 1, p 98-104, January-February 1970. 7 p, 7 fig, 1 tab, 14 ref.

Descriptors: *Karst, *Soil water movement, *Joints (Geology), *Fractures (Geology), *Fissures (Geology), Channel flow, Groundwater movement, Leaching, Caves, Limestones, Carbonate rocks, Soils, Soil formation, Soil chemistry, Soil classifications, Soil properties.
Identifiers: Karst soils.

Information about soils may be obtained from speleology, the study of caves. Some caves are shallow enough for roots of surface plants to be present in them. Cave maps and the distribution of stalactites on cave ceilings show that rock structure strongly controls the pattern of water movement through soil-rock columns. Relatively pure samples of some secondary minerals, formed at temperatures similar to those in the lower parts of overlying soils, may be obtained from caves. Dolomite seldom forms in caves, but calcite and aragonite are common. Impurities, including quartz, clay minerals, and iron oxides, are present in carbonate speleothems. Many speleothems have repeating growth increments (segments, rings). Some of these may be annual. When understood, they may give clues to, and dramatically portray, seasonal changes in the rate of flow and the composition of percolating waters. Studies of percolating waters from undisturbed soil-rock columns could be made using caves, but it would be difficult to tell what area and volume of soil and rock contributed to the percolate. (Knapp-USGS)
W70-06115

MEASURING UNSATURATED SOIL MOISTURE FLOW WITH A METER,
Agricultural Research Service, Kimberly, Idaho. Snake River Conservation Research Center.
J. W. Cary.
Soil Science Society America Proceedings, Vol 34, No 1, p 24-27, January-February 1970. 4 p, 5 fig, 2 tab.

Descriptors: *Soil moisture meters, *Soil water movement, Flowmeters, Instrumentation, Unsaturated flow, Hydraulic conductivity.
Identifiers: Soil moisture flowmeter.

A meter for measuring unsaturated soil moisture flow was constructed and tested in the laboratory. The meter was made from a single porous plate mounted in a thin brass cylinder. Flow through the meter was calculated from measurements of hydraulic head loss in the porous ceramic plate. The unit was calibrated in silt loam, silty clay, and loamy sand soils under nonisothermal but steady state conditions. It responded to water vapor flow induced by thermal gradients, as well as to liquid flow. Transient tests made in the silt loam soil indicated that it is possible to calibrate the meter under such conditions. Design analysis indicates that increasing the length of the cylinder reduces the sensitivity of the meter's calibration to changes in soil moisture content. (Knapp-USGS)
W70-06116

A COMPARISON OF TWO METHODS FOR DETERMINING SOIL WATER DIFFUSIVITY,
Iowa State Univ. of Science and Technology, Ames. Dept. of Agronomy.
H. M. Selim, Don Kirkham, and M. Amemiya.
Soil Science Society America Proceedings, Vol 34, No 1, p 14-18, January-February 1970. 5 p, 7 fig, 1 tab, 12 ref. AEC Contract AT (11-1)-1269, Report No 000-1269-17.

Descriptors: *Soil water movement, *Diffusivity, *Laboratory tests, *Soil moisture meters, *Nuclear moisture meters, Porous media, Unsaturated flow, Darcys law, Mathematical models, Hydraulic models, Permeameters.
Identifiers: Soil water diffusivity.

Two methods were used concurrently to determine the soil water diffusivity from horizontal infiltration of water into a soil column. In the first, water content measurements were taken at a fixed position as a function of time by using the gamma attenuation technique. In the second, water content distance distributions were determined as a function of distances from the water source at a fixed time by sectioning the same column. A comparison by the two methods of the diffusivity function for three soil materials showed that the first method is as reliable as the second. Agreement of the diffusivities obtained from the two methods is considered evidence of the validity of the unsaturated water flow equation. (Knapp-USGS)
W70-06117

INVERSE FORMULATION AND FINITE DIFFERENCE SOLUTION TO PARTIALLY SATURATED SEEPAGE FROM CANALS,
Utah State Univ., Logan. Dept. of Civil Engineering; and Computer Sciences Corp., Richland, Wash.
Roland W. Jeppson, and R. William Nelson.
Soil Science Society America Proceedings, Vol 34, No 1, p 9-14, January-February 1970. 6 p, 2 fig, 12 ref.

Descriptors: *Canal seepage, *Saturated flow, *Unsaturated flow, *Soil water movement, Computer programs, Mathematical models, Seepage, Groundwater movement, Steady flow, Unsteady flow, Flow nets.
Identifiers: Finite difference method, Partially saturated flow.

The mathematical model describing Darcian flow of water through soils approximates actual occurrences more closely when it permits regions of the flow to be partially saturated. A generally accepted relationship between effective permeability and capillary pressure is utilized to formulate and solve by inverse methods with finite differences the steady-state flow system of water through soils. The approach is applied to the problem of seepage from a canal to a water table. A computer program (FORTRAN IV) was written for solving this problem. (Knapp-USGS)
W70-06118

SOIL WATER EVAPORATION AS AFFECTED BY WETTING METHODS AND CRUST FORMATION,
Agricultural Research Service, Fort Collins, Colo.; and Colorado State Univ., Fort Collins. Dept. of Soil Science.
For primary bibliographic entry see Field 02D.
W70-06119

FLOW THROUGH POROUS MEDIA,
Princeton Univ., N.J.
For primary bibliographic entry see Field 02F.
W70-06154

2H. Lakes

THE ECOLOGY OF PERIPHYTON IN WESTERN LAKE SUPERIOR: PART I - TAXONOMY AND DISTRIBUTION,
Minnesota Univ., Minneapolis. Water Resources Research Center.
Jackson L. Fox, Theron O. Odlaug, and Theodore A. Olson.
Available from the Clearinghouse as PB-191 214, $3.00 in paper copy, $0.65 in microfiche. Minnesota University Water Resources Research Center Bulletin 14, August 1969. 127 p, 50 fig, 37 plate, 24 tab, 79 ref, append. OWRR Project No A-011-MINN.

Descriptors: *Lake Superior, *Periphyton, *Limnology, *Water quality, Bioindicators, Aquatic life, Aquatic algae, Water pollution effects.

Identifiers: Periphyton inventory (Lake Superior), Water quality indicators.

The plant portion of the epilithic periphyton of the western arm of Lake Superior was found to consist solely of representatives from three phyla of algae, the Chrysophyta, the Chlorophyta, and the Cyanophyta. Members of the phylum Chrysophyta were the most abundant organisms. Diatoms comprised over 90 per cent of the total number of organisms. The predominant genera were found to be Synedra, Achnanthes, Navicula, Cymbella, and Gomphonema. The mean total counts of organisms in the naturally occurring periphyton of Stony Point Bay, the primary sampling area, ranged from 497,000 per square centimeter of rock surface in 1966 to 1,470,000 per square centimeter in 1967. The biomass of the naturally occurring Stony Point Bay periphyton, in terms of dry weight, was 153 grams per square meter in 1965. The organisms found in the periphyton of the western arm of Lake Superior are indicative of clean water. The extensive shallow water area of Lake Superior supports large quantities of attached algae, which, as primary producers, form the first link in the food chain. (Knapp-USGS)
W70-05958

ON THE PRODUCTIVITY OF FIVE DANISH WATERS,
Gunnar Nygaard.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 12, p 123-133, 1953. 5 fig, 3 tab.

Descriptors: *Productivity, *Primary production, *Indicators, *Measurement, Oligotrophy, Trophic level, Dissolved oxygen, Lakes, Temperature.
Identifiers: *Compound Index, Gross production, Euthrophy, Denmark, Net production, Mesotrophy, Winkler technique, Carbon-14 technique, Maucha's method.

Five Danish lakes, varying from oligotrophic to eutrophic, were studied to test the Compound Index as an indicator of the trophic level of a lake. The Compound Index is defined as the summation of species of Myxophyceae, Chlorococcales, Centrales, and Euglenineae divided by the number of species of Desmidieae. Index values below 1.0 presumably indicate oligotrophy, values from 1.0 to 2.5 indicate mesotrophy and values exceeding 3.0 indicate genuine eutrophy. Index values dissolved oxygen curves and estimates of primary production show good correlation at the extremes of the range of index values. Less agreement was noted for lakes in the middle range of index values; lack of agreement was attributed to the small numbers of phytoplankton species present and to differences in transparency and color of the waters. Highest correlations are found where gross production is stated in a per-area rather than a per-volume basis. Graphical and tabular data include temperature and dissolved oxygen profiles and comparisons of Winkler and carbon-14 estimates of primary production. (Voigtlander-Wisconsin)
W70-05979

A POLLUTION STUDY OF WESTERN LAKE ONTARIO,
Municipal Labs., Hamilton (Ontario).
D. H. Matheson.
Michigan University, Institute of Science and Technology, Great Lakes Research Division Publication No 9, p 15-20, 1962. 3 fig, 1 tab.

Descriptors: *Path of pollutants, *Tracers, *Water pollution sources, Lake Ontario, Coliforms, Detergents, Thermal stratification, Depth-area-duration analysis, Tracking techniques, Indicators.
Identifiers: Ammonia nitrogen tracers, Coliform bacteria tracers, Synthetic detergents tracers, Hamilton Bay (Ontario).

Ammonia nitrogen, coliform bacteria, and sythetic detergents were used as tracers to study emission and distribution of polluted water from Hamilton Bay into Lake Ontario. Ammonia nitrogen was the most useful tracer because of concentrations of 5-6 ppm in the bay waters and its relative absence in uncontaminated lake water. Contour maps of average annual distribution of ammonia-nitrogen in western Lake Ontario for 1960 and 1961 are included. Highest levels were found near Burlington canal, along Hamilton Beach and the north shore. Patterns varied daily, depending on wind velocity and direction. High ammonia concentrations occurred in surface samples during thermal stratification due to spread of warm bay water over colder lake water. Average values of coliform organisms in Lake Ontario showed a distribution very similar to that shown by ammonia, with higher concentrations along both the beach shore and the north shore. Concentrations rapidly declined away from shore. Coliform bacteria showed a more complicated pattern than ammonia attributable to effects of previous emissions. Synthetic detergents provided a unique and useful tracer because they are not subject to removal by consumptive processes; however, their use is complicated since background concentrations can build up confusing the pattern of recent additions. (Haskins-Wisconsin)
W70-05984

IN SEARCH OF A CLEAR SOLUTION,
For primary bibliographic entry see Field 05C.
W70-05986

WASTEWATER POLLUTION AND GENERAL EUTROPHICATION OF A HYDROELECTRIC IMPOUNDMENT,
Department of Health, Rotorua (New Zealand).
For primary bibliographic entry see Field 05C.
W70-05987

AN ATTEMPT TO DETERMINE THE PRIMARY PRODUCTION OF THE GREEN SULPHUR BACTERIA, CHLOROBIUM LIMICOLA NADS, (CHLOROBACTERIACEAE),
Bialystok Medical Academy (Poland). Dept. of Biology.
Bazyli Czeczuga.
Hydrobiologia, Vol 31, No 1, p 317-333, 1968. 13 fig, 18 ref.

Descriptors: *Primary productivity, *Sulfur bacteria, Temperature, Oxygen, Hydrogen sulfide, Light penetration, Optical properties, Depth, Surfaces, Chlorophyll, Carbon radioisotopes, Photosynthesis, Phytoplankton, Organic matter, Sodium compounds, Spectrophotometers, Meromixis, Hypolimnion, Epilimnion, Thermocline.
Identifiers: *Chlorobium limicola Nads, *Chlorobacteriaceae, Lake Wadolek (Poland), Lake Popowka Mala (Poland), Transparency, Assimilation, Green sulfur bacteria, Suwalki (Poland), Holomictic, Lake Kisajno (Poland), Mazurian Lake District (Poland).

Primary production of the green sulfur bacteria, Chlorobium limicola Nads (Chlorobacteriaceae), was studied using labelled carbon. The amount of oxygen, hydrogen sulfide, chlorophyll, water transparency at various depths, and penetration of light rays into the lake were investigated and the following conclusions reached: at the depths where hydrogen sulfide replaces oxygen and to which light penetrates, large amounts of green sulfur bacteria, Chlorobium limicola, occur. By means of carbon-14, it was determined that maximum assimilation of carbon occurs at the depth where Chlorobium limicola is present. Doubtless, carbon assimilation at that depth is due to Chlorobium limicola. As a result of photosynthesis of the green sulfur bacteria, the assimilation of carbon reaches 37.7 milligrams/cubic meter in Lake Wadolek and 177 milligrams/cubic meter in 24 hours in Lake Popowka Mala, Poland. Where the phytoplankton primary production in a column of water with a surface area of a square meter is considered 100%, the primary production of Chlorobium limicola consists of 13.4 to 168.8%. Maximum green sulfur bacteria production occurs at depth to which 1% of the light rays penetrate. (Jones-Wisconsin)
W70-05991

SECOND REPORT OF THE REGULAR LIMNOLOGICAL SURVEY OF LAKE BIWA (1967). I. PLANKTON IN GENERAL AND PHYTOPLANKTON,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
Ken-ichiro Negoro.
Memoirs of the Faculty of Science, Kyoto University, Series of Biology, Vol 2, No 1, p 72-91, 1968. 11 tab, 2 ref.

Descriptors: *Plankton, *Phytoplankton, Sampling, Volume, Depth, Surfaces, Seasonal, Copepods, Zooplankton, Distribution, Succession, Chrysophyta, Pyrrophyta, Chlorophyta, Cyanophyta, Scenedesmus, Chlamydomonas, Speciation, Varieties, Lakes, On-site data collection, Distribution patterns.
Identifiers: Lake Biwa (Japan), Japan, Species composition, Limnological survey.

The 1967 Lake Biwa survey of total plankton and phytoplankton, volume of total plankton at 15 stations and 7 depth zones, volume of total plankton at the surface at 3 stations, and the mean volume of total plankton in each month during the past 10 years in the main basin, at 4 different depth zones, are presented. Using precipitated material, volume of phytoplankton may easily be read when zooplankton is composed of relatively large animals, such as Copepoda or Cladocera, and the colored phytoplankton is laid on the colorless zooplankton. Volume is difficult to read when zooplankton is composed of relatively small animals perfectly mixed with the phytoplankton, and is open to error. The volume of phytoplankton in the main basin was measured at 12 stations and 7 depth zones, as was volume ratio of phytoplankton:zooplankton. Zonal distribution, seasonal phytoplankton succession, number of species, and number of cells or colonies in the main basin are summarized together with monthly composition and distribution, species and cell (or colony) numbers derived from 3 stations at the accessory basin. (Jones-Wisconsin) (See also W70-05995).
W70-05994

SECOND REPORT OF THE REGULAR LIMNOLOGICAL SURVEY OF LAKE BIWA (1967). II. ZOOPLANKTON,
Osaka Medical Coll. (Japan).
Kokichi Yamamoto.
Memoirs of the Faculty of Science, Kyoto University, Series of Biology, Vol 2, No 1, p 92-106, 1968. 1 fig, 3 tab, 4 ref.

Descriptors: *Zooplankton, Limnology, Seasonal, Sampling, Depth, Temperature, Daphnia, On-site data collections, Lakes, Speciation, Varieties, Distribution patterns.
Identifiers: *Limnological survey, Lake Biwa (Japan), Japan, Difflugia brevicolla Cash, Species composition, Trichocerca chattoni, Plankton rotatoria, Rattulus cylindricus.

A list of zooplankton, resulting from the limnological survey of Lake Biwa in 1967, is presented. The number per cubic meter of various zooplankters are given, with their specific names and seasonal changes. A testacean rhizopod, described earlier as Difflugia brevicolla Cash, is now identified as Difflugia (Pseudocucurbitella) pseudogramen G Lievre et Thomas. A species of plankton rotatoria, Trichocerca chattoni (de Beauchamp), was collected from many localities in Lake Biwa, occurring usually above 15 meters, and especially abundant in layers less than 5 meters deep, and never collected from the neighboring lagoons; it is apparently an epilimnetic euplankton. This specie had not been reported in Japan until 1964 and has seldom been reported elsewhere in the world, being first described as a new variety of Rattulus cylin-

dricus. Morphological characteristics are briefly given. A table is included of Trichocerca chattoni noted in Lake Biwa, giving counts per cubic meter at the various regions, zones, and temperatures. Samples of zooplankton from the different stations were made at various depths in the southern and northern basins, and the number per cubic meter recorded. (Jones-Wisconsin) (See also W70-05994).
W70-05995

THE ALGAE OF SALINE AND FRESHWATER LAKES IN THE LOWER GRAND COULEE, WASHINGTON,
Washington State Univ., Pullman.
Richard W. Castenholz.
Washington State University Research Studies, Vol 28, No 4, p 125-155, 1960. 2 fig, 4 tab, 24 ref.

Descriptors: *Algae, *Lakes, *Fresh water, *Saline lakes, *Washington, Grand Coulee Dam, Marshes, Cyanophyta, Diatoms, Seasonal, Chlorophyta, Euglenophyta, Oregon, North Dakota, Marsh plants.
Identifiers: *Lower Grand Coulee lakes (Wash), Saskatchewan lakes, North Dakota lakes, Eastern Oregon lakes, Saline lake flora, Freshwater flora, Marsh epiphytes, Benthal mats, Epilithic crust formers, Salinity tolerance, Blue-green algae, Benthic plankton.

Non-planktonic algae of saline and freshwater lakes in the Lower Grand Coulee were collected. The 'salinity' of the saline lakes varied greatly while the freshwater lakes ranged from 0.25%-0.4%. The saline flora was depauperate in number of taxa but there were large amounts of benthal blue-green algae (a shifting mass of bentho-plankton) and diatoms with blue-greens forming epilithic coatings. Most blue-green algae showed little seasonality but the majority of diatoms were abundant during colder periods. The freshwater flora consisted of over 240 algal species and varieties. Blue-green algae were most abundant in summer as epiphytes in marshes, as benthal mats in open lakes, as epilithic crustformers, and phytoplankton; green algae were very common during warmer months; Spirogyra formed dense benthal mats. Cladophora was the dominant epilithic and epiphytic green alga. Diatoms were epilithic and epithytic, forming thick yellow-brown slime on rocks and macrophytes. Salinity tolerances of various diatom species are discussed, based on distribution in lakes of the Lower Grand Coulee, Saskatchewan, North Dakota, and eastern Oregon. With continued salinity decrease in two of the Grand Coulee lakes, a considerable change in flora is expected. (Jones-Wisconsin)
W70-05999

ROLE OF BACTERIA IN THE DYNAMICS OF IRON IN LAKE KRASNOE,
Leningrad State Univ. (USSR). Limnology Lab.
V. G. Drabkova, and E. A. Stravinskaya.
Microbiology, Vol 38, No 2, p 304-309, 1969. 2 fig, 9 ref.

Descriptors: *Iron bacteria, *Iron, *Bacteria, Dynamics, Runoff, Dissolved oxygen, Mud, Seasonal, Winds, Stratification, Cycles, Ice, Hydrogen ion concentration, Color, Temperature, Distribution, Bottom sediments.
Identifiers: *Lake Krasnoe (USSR), Metallogenium personatum Perf, Siderosapsa treubii Mol, Gallionella ferruginea Ehrenb, Gallionella planctonica Ras, Gallionella minor Chol, Gallionella major Mol, Gallionella, Vertical stratification.

Seasonal changes of iron concentration (total, dissolved, and divalent) and content of iron bacteria in lake water were studied to clarify the role of microorganisms in the iron cycle. Seven species of iron bacteria were found in Lake Krasnoe water: Metallogenium personatum Perf, Siderosapsa treubii Mol, Gallionella ferruginea Ehrenb, Gallionella planctonica Ras, Gallionella minor Chol, Gallionella major Mol, and Gallionella sp. During winter, surface layers of water are enriched with iron from surface runoff; in summer, during stagnation period, the oxygen-poor bottom layer of water is enriched with iron due to uptake from mud deposits. Its maximum concentration in a 1-square meter water column was observed in May. Three seasonal maxima were recorded in iron bacteria growth: during spring, summer, and fall. Spring and fall population increases coincide with isothermal periods, and the summer increase coincides with intense wind mixing of water masses after stratification period. Usually, the mass development of iron bacteria was observed at periods of open water and involved a decrease of total iron content and its reduced form, indicating a noticeable role of microorganisms in the oxidation and deposition of iron at this period. (Jones-Wisconsin)
W70-06000

TERRESTRIAL HEAT FLOW MEASUREMENTS ON LAKE TITICACA, PERU,
California Univ., San Diego, La Jolla; and Scripps Institution of Oceanography, San Diego, Calif. Marine Physical Lab.
J. G. Sclater, V. Vacquier, and J. H. Rohrhirsch.
Earth and Planetary Science Letters, Vol 8, No 1, p 45-54, March 1970. 10 p, 6 fig, 4 tab, 9 ref.

Descriptors: *Geothermal studies, *Heat flow, *Lakes, Thermal conductivity, Bottom sediments, Water temperature.
Identifiers: *Lake Titicaca, *Peru.

Between 29 May and 16 June, 1969, 19 successful observations of terrestrial heat flow were made with Bullard-type probes on Lake Titicaca within the 250-m depth curve. The 19 heat-flow measurements have a mean of 1.32 microcal/sq cm/sec (h.f.u.) which is slightly below the continental average. The differences of temperature gradient found at four depths in the lake sediments can be accounted for by an annual variation of the bottom water of approximately 0.02 deg C by comparing them to the computed penetration into the lake bottom of an annual sinusoidal oscillation of the bottom water temperature. At each of five stations the water column was nearly isothermal from a depth of 50 m to the bottom. Above 50 m the temperature rises, reaching about 14 deg C at the surface. Normal faults running along the axis of the lake may separate an eastern Devonian-Cretaceous province from a western Tertiary province. This boundary lies just west of Isla Soto. The mean heat flow in the Tertiary province appears to be significantly higher than in the Devonian-Cretaceous province. This difference might reflect a greater content of radioactive elements in and under the Tertiary terrain. (Knapp-USGS)
W70-06141

AN INVENTORY OF LARGE LAKES IN CALIFORNIA,
Geological Survey, Menlo Park, Calif. Water Resources Div.
J. R. Crippen.
Geological Survey Open-file report, September 1969. 11 p, 1 tab.

Descriptors: *Lakes, *Surveys, *Data collections, *California, Census, Water supply, Streamflow, Limnology, Inflow.
Identifiers: California Lake Inventory.

The U. S. Geological Survey has tabulated data on 169 lakes and reservoirs in California of more than 1 square mile in surface area. Included in this tabulation are location, area and altitude of the water surface, drainage area, and principal inflow. (Knapp-USGS)
W70-06149

SPECIFIC PROBLEMS IN LAKES,
Wisconsin Univ., Madison. Dept. of Bacteriology.
William B. Sarles.
Algae and Metropolitan Wastes, US Dep of Health, Education, and Welfare, Div of Water Supply and Pollution Control; and Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Technical Report, SEC TR W61-3, p 10-18, 1961.

Descriptors: *Lakes, *Wisconsin, *Urbanization, *Productivity, *Aesthetics, Fertilization, Eutrophication, Sewage disposal, Legislation, Administration, History, Planning, Sewage treatment, Algae, Odors, Agricultural watersheds, Governments, Water pollution, Copper sulfate, Fish diseases, Industrial wastes, Diversion, Watersheds (Basins).
Identifiers: *Madison (Wis), Yahara River (Wis), Lake Mendota (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis), Lake Wingra (Wis), Stoughton (Wis), Nine Springs Treatment Plant (Wis), Middleton (Wis), Dane County (Wis), Badfish Creek (Wis), Environmental quality, Macrophytes, Nuisance conditions, Plant nutrients, Lake Monona (Wis).

The Madison, Wisconsin, five lakes (Mendota, Monona, Waubesa, Kegonsa, Wingra) have historically been subjected to influences of eutrophication, including both urban wastes and extensive agricultural drainage. The consequent obnoxious effects have prompted diverse and numerous efforts for their control, including community action, legislation, executive study, scientific research, administrative fiat, and legal action. This study is a short summary of the tangled history of activities which finally led to understanding the difference between nuisance conditions caused by pollution with solid sewage wastes and those due to pollution with plant nutrients, and, ultimately, to diversion of effluents around the chain of lakes from Madison's efficient secondary treatment plant. This case history study raises unanswered questions bearing on the possibilities of creating or extending sewerage districts to combat effects of urbanization; of improving sewage treatment to remove plant nutrients; and developing stream and lake management procedures which will control nuisance conditions without harming fish and other aquatic life. (See W70-04506) (Eichhorn-Wisconsin)
W70-06213

THE BIOLOGICAL EFFECT OF COPPER SULPHATE TREATMENT ON LAKE ECOLOGY,
Wisconsin Committee on Water Pollution, Madison.
Kenneth M. Mackenthun, and Harold L. Cooley.
Wisconsin Academy of Sciences, Arts and Letters, Vol 41, p 177-187, 1952. 7 tab, 18 ref.

Descriptors: *Biology, *Effects, *Copper sulfate, *Treatment, *Lakes, *Ecology, Bottom sediments, Mud, Benthos, Wisconsin, Sampling, Contours, Depth, Oligochaetes, Toxicity, Fish, Bloodworms, Algal control.
Identifiers: Lake Mendota (Wis), Lake Monona (Wis), Lake Nagawicka (Wis), Lake Pewaukee (Wis), Chironomus, Procladius, Corethra punctipennis, Pisidium idahoense, Tendipes plumosus, Beaver Dam Lake (Wis), Delavan Lake (Wis).

These studies were designed to determine the effect of accumulated copper in bottom muds, applied as copper sulfate for algal control, on bottom dwelling organisms which are available as fish food. Although the toxic limit of copper sulfate, precipitated and accumulated in bottom muds, upon certain types of bottom-dwelling organisms could not be accurately determined in the time allotted, laboratory tests indicate that it is near 9000 parts/million copper on a dry-weight basis. Results indicate that copper accumulation in bottom muds, due to usage of copper sulfate to control algae in hard water lakes, is considerably lower in concentration than the amounts experimentally determined to have a deleterious effect on the profundal bottom-dwelling organisms studied. These studies indicated that differences occurring in the population density of bottom organisms in the four Wisconsin lakes studied are due to ecological variables within these separate bodies of water. (Jones-Wisconsin)
W70-06217

THE LIMNOLOGY OF CANYON FERRY RESERVOIR. IV. THE ESTIMATION OF PRIMARY PRODUCTION FROM PHYSICAL LIMNOLOGICAL DATA,
Montana State Coll., Bozeman. Dept. of Botany and Microbiology.
John C. Wright.
Limnology and Oceanography, Vol 6, p 330-337, 1961. 2 fig, 4 tab, 17 ref.

Descriptors: *Primary productivity, *Oxygen, Photosynthetic oxygen, Metabolism, Heat exchange, Lakes, Hypolimnion, Reservoirs, Analytical techniques, Heat budget.
Identifiers: Vertical eddy conductivity, Birgean heat budgets, Eddy coefficients, Oxygen consumption, Oxygen balance, Heat transport equation, Holomictic lakes, Oxidative metabolism, Canyon Ferry Reservoir.

The biological production and consumption of oxygen was computed as the sum of turbulent transport of oxygen and oxygen concentration at successive depths. The coefficients of vertical eddy diffusivity were calculated from heat transport equation utilizing Birgean heat budgets. The coefficients decreased with depth of epilimnion, attained the minimum values in the metalimnion, and increased in the hypolimnion. Below 5.5 meter depth, the oxygen consumption exceeded production. In the euphotic zone, oxygen production, equivalent to dysphotic zone oxygen consumption, averaged 1.01 gram oxygen/square meter per day. Considering the ratios of oxygen consumption:chlorophyll and oxygen consumption:seston, the daily respiration of euphotic zone was 1.44 gram oxygen/square meter per day and 2.01 gram oxygen/square meter per day, respectively. Gross production values approached those for black and clear bottle estimates of 3 grams oxygen/square meter per day. (Wilde-Wisconsin)
W70-06218

ECOLOGY AND BIOLOGICAL PRODUCTION OF LAKE NAKA-UMI AND ADJACENT REGIONS. 2. AN ATTEMPT OF COMPARING THE PRODUCTIVITY OF LAKE SHINJI-KO AND LAKE NAKA-UMI ON THE BASIS OF INPUT AND OUTPUT OF TOTAL PHOSPHORUS,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
Syuiti Mori.
Special Publication Seto Marine Biological Laboratory Series II, Part 1, p 9-19, 1964. 2 fig, 6 tab, 11 ref.

Descriptors: *Lakes, *Phosphorus, *Ecology, *Limnology, Productivity, Methodology, Rivers, Inflow, Discharge (Water).
Identifiers: Japan, Lake Shinji-ko, Lake Naka-umi, Uptake.

Total phosphorus (P) contents of two Japanese lakes and amounts of P in inlet and outlet waters were measured for one year. Productivities of the two lakes were also compared. Values of G (P assimilated by organisms) for the year were -144.7 metric tons for Shinji-ko and -243.7 tons for Naka-umi, where negative values (negative growth) indicate death and disintegration of organisms. Estimates of P input per cubic meter of water were 2.33 grams for Naka-umi and 1.02 grams for Shinji-ko. Phosphorus retention was also greater in Naka-umi (20% loss of input P versus 41% loss for Shinji-ko), thus indicating that productive activity was greater in Naka-umi. Tabular data include monthly estimates of P concentration and total P in vertical depth strata of the lakes and in inlet and outlet streams. Also included are formulae for computing total P budgets. (Voigtlander-Wisconsin)
W70-06221

FACTORS CONTROLLING PRIMARY PRODUCTIVITY, ESPECIALLY WITH REGARD TO WATER REPLENISHMENT, STRATIFICATION, AND MIXING,
Biological Station, Lunz am See (Australia).
Ingo Findenegg.
Memorie dell'Istituto Italiano di Idrobiologia, Supplement 18, p 105-119, 1965. 5 fig, 2 tab, 8 ref.

Descriptors: *Limnology, *Primary productivity, *Stratification, Lakes, Standing crop, Phosphorus, Nitrogen, Nutrients, Epilimnion.
Identifiers: Upwelling waters, Alpine lakes, Lake Constance, Klopeiner See (Austria), Worthersee (Austria).

Primary production in lakes is controlled by the interaction of three groups of factors: physical, nutrient content, and interaction of organisms present. Production takes place in non-homogeneous layers; considerable gradients of temperature and concentration occur. Water replenishment of lakes has two main effects: changing physical and chemical qualities and removing a portion of the standing plankton crop from the system. Upwelling of deeper strata can also act in replenishing trophogenic layers, occurring through wind-driven tilting of the thermocline, and which can result in nutrient replacement in the photosynthetic layers. Where sharp temperature gradients result in stable thermoclines, production is limited to the epilimnion and dependent on nutrients brought up by the spring circulation. In alpine lakes, which are sheltered from wind, epilimnetic production is often less than metalimnetic production, the latter due to high transparency, sinking of seston and horizontal transport of nutrients from the littoral mud-water interface. (Voigtlander-Wisconsin)
W70-06222

EFFECT OF DIFFERENT FERTILIZERS ON YIELD OF GOLDEN SHINERS IN NEW YORK PONDS,
Cornell Univ., Ithaca, N.Y. Dept. of Conservation.
John L. Forney.
New York Fish and Game Journal, Vol 15, No 1, p 112-116, 1968. 1 fig, 1 tab, 8 ref.

Descriptors: *Fertilization, *Farm ponds, *Fish farming, *Pounds fish per acre, Phytoplankton, Fish, Fish harvest, Phosphorus, Nitrogen, Standing crop.
Identifiers: *Golden shiners, *Fish culture, Manure, Notemigonus crysoleucas.

Six ponds, ranging in area from 0.21 to 4.5 acres (0.09 to 1.82 hectares), were stocked with adult golden shiners and fertilized with manure (1000 lbs/acre--1121 kilograms/hectare (kg/ha)) and inorganic 5-10-5 fertilizer (100 lbs/acre--121 kg/ha). Additional fertilizer treatments were made at two levels of application, each level applied to three ponds. Phytoplankton blooms occurred in ponds receiving highest fertilization; plankton blooms in lower-fertilized ponds were delayed and in lesser intensity. First-year standing crops of golden shiners from ponds treated with a lower level of inorganic fertilizer plus manure, averaged 208 lbs/acre (233 kg/ha) compared with 176 lbs/acre (197 kg/ha) for ponds receiving only high inorganic fertilizer treatments. Repeated experiments with different fertilizer applications yielded standing crops of 500 lbd/acre (560 kg/ha) as opposed to 145 lbs/acre (163 kg/ha) for the unfertilizedcontrol pond. Addition of phosphorus was apparently the prime factor in increasing yield; addition of nitrates apparently had no effect. Effects of fertilization may be difficult to detect in 1-year studies in northern ponds. (Voigtlander-Wisconsin)
W70-06223

THE HISTORY OF THE CLADOCERAN FAUNA OF ESTHWAITE WATER (ENGLAND) AND ITS LIMNOLOGICAL SIGNIFICANCE,
Indiana Univ., Bloomington. Dept. of Zoology.
Clyde E. Goulden.
Archiv fur Hydrobiologie, Vol 60, No 1, p 1-52, 1964. 8 fig, 3 tab, 76 ref.

Descriptors: *Sediments, *Crustaceans, *Paleolimnology, Productivity, History, Cores, Diptera, Varieties, Midges, Eutrophication.
Identifiers: *Cladocera, Esthwaite Water (England), Bosmina, Chironomus, Ceriodaphnia, Species diagnosis, Ostracoda.

Analysis of two sediment cores from the north basin of Esthwaite Water yielded 37 species of Cladocera of which 23 species were chydorids. Five periods of cladoceran development were noted, each being correlated with climatic or cultural changes in the drainage basin. Littoral Cladocera (chydorids) reached their greatest development during first (Allerod) period; the second period of abundance (immediate post-Glacial) showed a similar fauna. Planktonic Cladocera showed greatest abundance in the third (Boreal) period. The remaining periods of abundance corresponded with the arrival of Neolithic man and with increased agricultural activity following the Norse immigration. Associated with presumed increased eutrophication due to agricultural activities were faunal changes, including the replacement of Bosmina coregoni by B longirostris, replacement of the Tanytarsus-Sergentia midge community by Chironomus, and appearance of one new Daphnia species and three species of Ceriodaphnia. Tabular and graphical data include occurrence of all species by depth in the core samples. (Voigtlander-Wisconsin)
W70-06224

LIMNOLOGICAL ASPECTS OF RECREATIONAL LAKES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
Kenneth M. Mackenthun, William M. Ingram, and Ralph Porges.
Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC, 20402, Price $4.25.U S Dep of Health, Education, and Welfare, Public Health Service Publication No 1167, 1964. 176 p, 11 fig, 9 tab, 52 plates, 448 ref.

Descriptors: *Limnology, *Lakes, *Recreation, Reservoirs, Ponds, Temperature, Light penetration, Dissolved oxygen, Bicarbonates, Hydrogen ion concentration, Nuisance algae, Aquatic plants, Bottom sediments, Animals, Fish, Inflow, Outlets, Nutrients, Productivity, Photosynthesis, Eutrophication, Toxicity, Midges, Mosquitoes, Sampling, Control, Industrial wastes, Tennessee, Shore-line cover, Snails, Wisconsin, Human disease, Game birds, Technology, Population.
Identifiers: Leeches, Schistosome cercariae, TVA reservoirs, Anopheles quadrimaculatus, Madison (Wis), Psorophora ciliata, Artificial key.

This book considers the many problems associated with the recreational use of lakes, reservoirs, and ponds, and is directed toward interpretation of problems and management of the recreational lake phenomena. Chapters consider the general problem of aquatic nuisances; review the ecology of lakes, reservoirs and ponds and present information on biotic production, leading to an understanding of the scope and magnitude of basic nuisance problems; discuss nutrients from sewage and runoff and their impact on biological growths; review plant and animal pests affecting recreational water; present simple keys with illustrations for identification of some common aquatic plants; discuss the mechanics of establishing a sampling program for a lake, reservoir, or pond to determine the present state of biological growths and possibly predict future trends; and present information for control or alleviation of excessive production of biological nuisances. Knowledge of the mutual relations between organisms and their environment is necessary for instigation of an effective control program. A glossary is included. (Jones-Wisconsin)
W70-06225

POPULATION AND PRODUCTION ECOLOGY OF ZOOPLANKTON IN OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND,
Dalhousie Univ., Halifax (Nova Scotia).
Ian A. McLaren.

Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1485-1559, 1969. 33 fig, 12 tab, 44 ref.

Descriptors: *Fjords, *Ecological distribution, *Population, *Ecology, Lakes, Life history studies, Secondary productivity, Productivity, Biomass, Zooplankton, Saline water intrusion, Marine animals, Aquatic microorganisms.
Identifiers: Ogac Lake (Canada), Pseudocalanus minutus, Oithona similis, Sagitta elegans, Aglantha digitale.

Detailed life-history studies are presented, based on collections of zooplankton from the three basins of the lake and from a fertilized polyethylene column. The most abundant coepod, Pseudocalanus minutus, had an annual life cycle, spawning during the period of abundant food. Number of young per brood was female-size-dependent; number of broods was independent of food supply. Oithona similis had a similar life cycle, but showed different food requirements. Sagitta elegans individuals were smaller than those in the sea; size of new generations was proportional to number of adults but food-independent. Other organisms present in the collections included the medusa Aglantha, ctenophores, Eurytemora, and bivalves. Owing to the marked seasonality of the lake, controls of population size and growth occur when food is in excess. Vertical migration may be adapted for growth and development control and to maximize rates of increase in thermally stratified waters. Total zooplankton production was estimated at 1 gram carbon/square meter per year, about 7% of primary production. Predator production ranged from 16 to 68% of herbivore production; production/biomass ratios averaged about 3:1 but wide variations occurred. The conclusion is that production can only be measured or explained with the aid of detailed, quantitative life-history studies. (Voigtlander-Wisconsin)
W70-06226

DIATOMS FROM SOME INLANDWATERS OF THE ANTARCTICA,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
Ken-ichiro Negoro.
Memoirs of the Faculty of Science, Kyoto University, Series of Biology, Vol 1, No 2, p 125-138, 1968. 39 fig, 21 ref.

Descriptors: *Diatoms, *Antarctic, Fresh water, Marine algae, Winds, Bottom sediments, Sands, Mud.
Identifiers: *Inland waters, Japanese Antarctic Research, Navicula, Navicula muticopsis, Navicula perpusilla, Hantzschia amphioxys, Achanthes coarcata, Cocconeis, Amphora, Pinnularia borelais, Coscinodiscus, Diploneis Smithii, Amphora proteus, Paralia sulcata, Acrinocyclus birons, Cymbella norvegica, Synedra antarctica, Diploneis stigmosa, Denticula antarctica, Navicula austroshetlandica.

Collection of algal material by the First Wintering Party of the Japanese Antarctic Research Expedition from some inland waters of Antarctica yielded 22 species of diatoms, half belonging to freshwater forms and half to marine forms. Strong winds may be the most effective factor in distribution of marine diatoms into the inland Antarctica waters. The major freshwater diatoms may be Navicula muticopsis, Navicula perpusilla, Navicula austroshetlandica, Hantzschia amphioxys, Achnanthes coarctata var elliptica, and others. The material was collected on the East Ongul Island and Eutre Island, and from pools, bottom mud, and sand, and small lakes in the Langhovde Mountains. The distributions and percentage frequency of diatoms are given together with a brief description of each species. Among these diatoms only five forms were found in all three districts. Two species, namely Navicula austroshetlandica and Navicula muticopsis appear to be endemic freshwater diatoms in the inland waters of the Antarctica, at least around the Byowa Base of the Japanese Expedition. (Jones-Wisconsin)
W70-06227

SOME QUANTITATIVE ASPECTS OF ALGAL GROWTH IN LAKE MENDOTA,
Wisconsin Univ., Madison. Dept. of Zoology.
Donald E. Wohlschlag, and Arthur D. Hasler.
Ecology, Vol 32, No 4, p 581-593, 1951. 1 fig, 5 tab, 27 ref.

Descriptors: *Algae, *Plant growth, *Wisconsin, Ecology, Chemical analysis, Phytoplankton, Cyanophyta, Sediments, Plant populations, Weather, Water, Movement, Cultures, Bays, Streams, Weeds, Littoral, Winds.
Identifiers: *Lake Mendota (Wis), Pelagic areas, Horizontal, Blooms, Gelatinous matter.

Diverse areas of Lake Mendota show differences in quantities of algae, both seasonally and intraseasonally. Various bay areas and stream mouths, weedy littoral, and pelagic stations within bays have characteristic algal numbers. Certain stations retain characteristics from one season to the next, others vary on a seasonal basis. Where station individuality is indicated, it is present over and above temporal variation. Algal cultures derived from sediments exhibited characteristic differences from bay to bay and from station to station within bays. Generally, the same station individualities present in cultures were present in corresponding collections from overlying waters. Coarse, sandy sediments from the same locale produced more algae when obtained prior to ice-free spring circulation. The possible significance of blue-green algae to subsequent blooms is discussed. Algal concentrations appear greater at a littoral area after 48-hour onshore wind than at a similar unexposed area. Chlorophyll, chemical, and microscopic data suggest that sudden appearance of Diplocystis aeroginosa is accompanied by increase in gelatinous matter proportionately greater than increase in activity represented by chlorophyll increase. Wind produced sediment agitation is a possible agent in production of blue-green blooms relative to seasonal succession of algal blooms. (Jones-Wisconsin)
W70-06229

PRIMARY PRODUCTION AND WATER QUALITY IN SMITH MOUNTAIN LAKE, VIRGINIA,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
G. M. Simmons, Jr., and S. E. Neff.
Proceedings of the 17th Southern Water Resources and Pollution Control Conference, p 288-299, 1968. 5 fig, 2 tab, 12 ref. OWRR Project A-012-VA.

Descriptors: *Primary productivity, *Lakes, *Virginia, Reservoirs, Water pollution, Eutrophication, Oligotrophy, Water chemistry, Temperature, Hydrogen ion concentration, Dissolved oxygen, Thermal stratification, Hypolimnion, Photosynthesis, Water quality, Coliforms, Colorimetry, Nutrients, Lake morphology, Sewage effluents, Pumped storage, Hydroelectric power, Oxygen demand, Epilimnion.
Identifiers: *Smith Mountain Lake (Va), Appalachian Power Company, Alkalinity, Electrical-resistance thermometry, Winkler technique, Oxygen electrodes, Physical limology, Bathythermograph, Potentiometry, Radiocarbon uptake techniques, Roanoke River, Blackwater River, Metalimnion, Water monomictic lakes, Mean probable number technique.

Smith Mountain Lake, Virginia, is the upper reservoir of a two-reservoir, pumped-storage hydrogeneration system, which briefly recylces about 8000 cubic feet/second of water. Among morphometric data presented in the report, most pertinent are: area--22,058 acres; depth (maximum)--200 feet, (mean)--57 feet; volume--1,254,671 acre-feet; normal usable storage--150,000 acre-feet. Effects of recirculation on thermal stratification, water quality, and primary productivity at four stations in the impoundment were studied by standard limnological methods. Becoming homothermous in late October and circulating throughout winter, impoundment behaves as a warm monomictic lake. Although summer stratification is established, its intensity near the dam is reduced by periodic pump-back operation. Recycling also increases coliform count near dam, since some water from Pigg River--receiving untreated municipal sewage--is also repumped. Hypolimnetic oxygen is not completely exhausted, although ability of reservoir to metabolize allochthonous oxidizable matter will probably decrease with time. As determined from radiocarbon uptake, primary productivity is characteristic of oligotrophy, except in impoundment arm influenced by Roanoke-Salem urban area, where carbon assimilation is similar to that in lakes undergoing eutrophication from effluents. (Eichhorn-Wisconsin)
W70-06230

THE SHARE OF ALGAE, BACTERIA AND TRYPTON IN THE FOOD OF THE PELAGIC ZOOPLANKTON OF LAKES WITH VARIOUS TROPHIC CHARACTERISTICS,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
Z. M. Gliwicz.
Bulletin de l'Academie Polonaise des Sciences (Serie des Sciences Biologiques) Vol 17, No 3, p 159-165, 1969. 3 fig, 1 tab, 8 ref.

Descriptors: *Feeding rates, *Trophic level, *Algae, *Lakes, Bacteria, Zooplankton, Foods, Rotifers, Daphnia.
Identifiers: *Feeding studies, Cladocerans, Keratella, Bosmina, Chydorus, Eurytemora, Trypton.

Feeding experiments, utilizing in situ experimental chambers were performed on zooplankton populations of five lakes. The lakes varied from eutrophic to 'meso-oligotrophic' and diversity in zooplankton density ranged from 16,000 animals/square decimeter (mesotrophic) to 114,000 (eutrophic). Numbers of zooplankton per liter varied from 40 (meso-oligotrophic) to 268 (eutrophic). Grazing intensities and Ivlev's coefficient of food selectivity were calculated for all experiments, the latter from filtration experiments involving sand suspensions. Results indicate that in eutrophic lakes, rotifers and small cladocerans (Bosmina, Chydorus) are dominant and tend to feed extensively on minute (2-6 microgram) food particles. In more oligotrophic lakes, filtering copepods (Eudiaptomus, Eurytemora) assume higher proportions and incline to feed on larger (6-10 microgram) food particles. The conclusion is that, subject to the modifying action of numerical preponderance of algae and bacteria as food sources (i e, the extent of net primary production), the specific composition of zooplankton communities is the main factor determining food selectivity of such communities. (Voigtlander-Wisconsin)
W70-06232

THE PRODUCTION OF ORGANIC MATTER BY THE PHYTOPLANKTON IN A DANISH LAKE RECEIVING EXTRAORDINARILY GREAT AMOUNTS OF NUTRIENT SALTS,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
E. Steemann Nielsen.
Hydrobiologia, Vol 7, p 68-74, 1955. 2 fig, 4 ref.

Descriptors: *Nutrients, *Phytoplankton, *Productivity, Primary productivity, Water pollution effects, Sewage, Lakes, Carbon dioxide, Photosynthesis, Organic matter, Plankton, Phosphates.
Identifiers: Gross productivity, Denmark, Sollerod So (Denmark), Glucose.

Production of organic matter (glucose) was studied using the Gran method (light-dark bottles) in Sollerod So near Copenhagen. The lake receives large quantities of sewage effluent, resulting in minimum phosphate concentrations as high as 200 milligrams phosphorus pentoxide per square meter. Actual photosynthesis (gross production) calculated as carbohydrate/square meter of surface per day ranged from zero to nearly 10 grams glu-

cose/square meter per day. Peaks in production were noted in May, July (highest production) and September. Annual gross production was estimated to be 1300 grams glucose. Calculations suggest that maximum production was noted, since greater production would, through carbon dioxide consumption, increase pH to levels injurious to phytoplankton. Uptake of atmospheric carbon dioxide by the lake was estimated at 60 to 100 grams carbon dioxide/square meter of surface per month during the most productive season. The conclusion is that such uptake is the actual limiting factor for production of organic matter in the lake. (Voigtlander-Wisconsin)
W70-06233

FRESHWATER FISHES OF CONNECTICUT,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 02E.
W70-06236

2I. Water in Plants

SOIL NITRATE, SOIL WATER, AND GRAIN YIELDS IN A WHEAT-FALLOW ROTATION IN THE GREAT PLAINS AS INFLUENCED BY STRAW MULCH,
Agricultural Research Service, Mandan, N. Dak. Northern Plains Branch.
D. E. Smika, A. L. Black, and B. W. Greb.
Agronomy Journal, Vol 61, No 5, p 785-787, September-October 1969. 2 fig, 3 tab, 5 ref.

Descriptors: *Fallowing, *Mulching, *Soil water, *Crop production, *Semiarid climates, Great Plains, Crop response, Stubble mulching, Evaporation control, Water conservation, Water management (Applied), Soil-water-plant-relationships, Colorado, Montana, Nebraska, Wheat, Grains (Crops), Nitrates, Nitrogen, Nitrogen compounds, Fertilizers, Nutrient requirements.
Identifiers: *Soil nitrates, Bare fallow.

An experiment was undertaken to study the effects of straw mulch on soil nitrates and soil water in semiarid areas such as the Great Plains. At test sites in Colorado, Montana, and Nebraska it was found that mulch rates had to exceed 3,360 kg/ha before a significant reduction in soil nitrates occurred. Grain yield was not affected even at these lowered nitrate levels. In contrast, stored soil water at seeding correlated positively with wheat grain yield in 7 out of the 11 crop years under study. For the other 4 years there was no evidence that the decreased grain yield was caused by inadequate nitrogen supply. Although soil water and soil nitrate levels at end of fallowing are both very important factors in sustained crop production in semiarid areas, soil water exerts greater influence on grain yield. (Carr-Arizona)
W70-06002

TURFGRASS EVAPOTRANSPIRATION,
Agricultural Research Service, Boise, Idaho; Soil and Water Conservation Research Div.; and Nevada Agricultural Experiment Station, Reno.
For primary bibliographic entry see Field 02D.
W70-06003

MONITORING COTTON PLANT STEM RADIUS AS AN INDICATION OF WATER STRESS,
Texas Agricultural Experiment Station, College Station.
L. N. Namken, J. F. Bartholic, and J. R. Runkles.
Agronomy Journal, Vol 61, No 6, p 891-893, November-December 1969. 3 fig, 4 ref.

Descriptors: *Soil-water-plant relationships, *Moisture stress, Plant tissues, *Cotton, Drying, Moisture, Soil moisture, Plant physiology, Leaves, Instrumentation.
Identifiers: *Stem radius, *Leaf water potential, *Transducer, *Energy load, Stem.

Most methods of monitoring plant water stress are not only intermittent, but also destructive of plant tissue. In a new technique, microchanges in cotton plant stem radius during a drying cycle were measured with a linear variable displacement transducer. Degree of leaf water stress was directly related to plant stem contraction and stem radius was quite responsive to energy load changes at the evaporating surface. With the transducer it was possible to monitor relative plant water stress continuously without destroying plant tissue. (Carr-Arizona)
W70-06005

PERSISTENT, VERTICAL-MIGRATION RHYTHMS IN BENTHIC MICROFLORA. VI. THE TIDAL AND DIURNAL NATURE OF THE RHYTHM IN THE DIATOM HANTZSCHIA VIRGATA,
New York Univ., N.Y. Dept. of Biology; Marine Biological Lab., Woods Hole, Mass.; and Bristol Univ. (England). Dept. of Botany.
John D. Palmer, and Frank E. Round.
Biological Bulletin, Vol 132, No 1, p 44-55, 1967. 4 fig, 27 ref.

Descriptors: *Vertical migration, *Tides, *Diatoms, *Benthos, Intertidal areas, Protozoa, Sands, Euglena, Diurnal.
Identifiers: *Vertical migration rhythms, *Tidal rhythms, *Lunar-day rhythms, Ebb tides, Metazoa, Tidal exposure, Hantzschia, Barnstable Harbor (Mass), Hantzschia virgata.

During daytime low tides, sands of Barnstable Harbor, Massachusetts, attain green or golden brown coloration due to surface accumulation of the diatom Hantzschia virgata. With return of the tide, the organisms re-burrow into the sand. Shading of the area with opaque covering precludes emerging of the diatoms. When the low tide approaches sunset, the cells rephase their rhythm to early morning. It is postulated that migration rhythm is influenced by a lunar-day clock which measures 24.8 hours. (Wilde-Wisconsin)
W70-06235

2J. Erosion and Sedimentation

STILL-CONCENTRATED FLOW TRANSITIONS AND EXTENT OF EROSION,
City Coll., New York. Dept. of Civil Engineering.
Walter Rand.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7212, p 927-939, April 1970. 13 p, 10 fig, 1 tab, 6 ref, append.

Descriptors: *Erosion, *Open channel flow, *Hydraulic jump, *Transition flow, *Flow control, Hydraulics, Scour, Canals.
Identifiers: Sills (Hydraulic).

The distance is determined over which scour will develop downstream of a sill-controlled flow transition in an erodible open channel, in which the sediment motion is impending. This determination is based on the concept of dynamic similarity that makes it possible to relate the erosion length in an erodible channel to the total length of flow transition in a fixed-bed channel. Accordingly, prediction of the limiting extent of erosion becomes possible for a wide variety of sill-controlled flow transitions, including the case present in the hydraulic jump stilling basins, and the natural hydraulic jump. (Knapp-USGS)
W70-05908

FRICTION FACTORS AND BED FORMS IN FLUVIAL CHANNELS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
David Squarer.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7245, p 995-1017, April 1970. 23 p, 3 fig, 3 tab, 16 ref, append.
OWRR Project A-020-IA.

Descriptors: *Channel morphology, *Fluid friction, *Roughness (Hydraulic), *Meanders, *Sediment transport, Model studies, Hydraulic models, Ripple marks, Sedimentary structures, Statistical methods, Sediment discharge, Discharge (Water).
Identifiers: Stream bed geometry.

Bed-form geometry in a curved channel and a straight flume which are subject to the same nominal flow conditions is investigated by statistical analysis of records of stream bed profiles. A quantitative comparison between bed geometry in curved and straight channels is made in terms of the autocorrelation, spectral density and probability density function of a process defined by the bed elevation. The same statistical functions are used to evaluate the bed-friction factor and ripple celerities. It has been found from experiments that the total rate of sediment transport in the curved channel is approximately 15 times as much as that of a straight flume which is subject to nominally identical flow conditions. (Knapp-USGS)
W70-05911

ANALYSIS OF DATA ON SUSPENDED SEDIMENT DISCHARGE IN SEVERAL STREAMS IN ISRAEL,
Hebrew Univ., Jerusalem (Israel). Dept. of Geography.
M. Negev.
Israel Hydrological Service, Hydrological Paper No 12, 1969. 27 p, 7 fig, 9 tab, 7 ref, 2 append.

Descriptors: *Sediment transport, *Alluvial channels, *Arid lands, *Sediment load, Bed load, Suspended load, Sediment discharge, Discharge (Water), Sampling, Stream gages, Sedimentation, Data collections, Data processing, Regression analysis.
Identifiers: *Israel.

An analysis was conducted of some recently collected sediment data from six streams in Israel. In four of the streams sediment load is highly correlated with discharge alone, while in two streams a distinction between rising and falling stages, or an inclusion of 'between flood' variables improve the correlation. The sediment transport characteristics of the streams were compared with some properties of the watersheds. Hydrological and physical features of the watersheds provide plausible explanations for the observed trends. (Knapp-USGS)
W70-05925

THE BEHAVIOUR OF THE TURBULENT FLOW IN A 2-DIMENSIONAL OPEN CHANNEL IN PRESENCE OF SUSPENDED PARTICLES,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau und Erdbau.
Albert Gyr.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B2, p 9-16, 1967. 8 p, 3 fig, 5 ref.

Descriptors: *Turbulence, *Suspended load, Sediment transport, Vortices, Viscosity, Mathematical studies, Model studies, Mathematical models, Fluid friction.
Identifiers: Turbulence-suspended load relations.

The influence which particle suspensions have upon the turbulent flow character of a two-dimensional open channel flow is discussed. The decay of frictional resistance brought about by increasing the concentration of suspended material is investigated. A vortex model for the single turbulence ball is introduced which explains that the concentration of the suspended material and the viscosity is considerably variable, so that vortex diffusion is increased. This diffusion causes energy transfer from small to large vortices. This energy transfer is directly correlated with turbulent energy dissipation, which explains the connection between

the vortex model and frictional loss. Nevertheless it should be emphasized that this is a heuristical reflection, and no quantitative statements may be made. (Knapp-USGS)
W70-05948

EFFECT OF EROSION - CONTROL LAND TREATMENT ON FLOW FROM AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-06040

THEORETICAL STUDY OF HIGH-RATE SEDIMENTATION,
Camp, Dresser and McKee, Boston, Mass.
For primary bibliographic entry see Field 05D.
W70-06059

NONEQUILIBRIUM TRANSPORT OF SUSPENDED SEDIMENT,
Missouri Univ., Columbia. Dept. of Civil Engineering.
A. T. Hjelmfelt, and C. W. Lenau.
Available from the Clearinghouse as PB-191 247, $3.00 in paper copy, $0.65 in microfiche. Missouri University Water Resources Center Report, 1969. 28 p, 6 fig, 10 ref, 9 append. OWRR Project No A-017-MO.

Descriptors: *Sediment transport, *Erosion, *Scour, *Suspended load, *Mathematical studies, Mathematical models, Sediment discharge, Sediment load, Equilibrium.
Identifiers: Nonequilibrium sediment transport.

Nonequilibrium suspended sediment transport is analyzed mathematically as a steady state phenomenon. Sediment-free water is assumed to enter a movable-bed channel and pick up sediment until equilibrium is reached. Curves of constant concentration are plotted. (Knapp-USGS)
W70-06097

SHIFTS OF SEDIMENT CONCENTRATION IN A VERTICAL PIPE,
Aberdeen Univ. (Scotland). Dept. of Engineering.
B. B. Willetts.
Journal of Hydraulic Research, Vol 8, No 1, p 109-122, 1970. 14 p, 5 fig, 4 graph, 10 ref.

Descriptors: *Sediment transport, *Laboratory tests, *Model studies, *Turbulent flow, Pipe flow, Turbulence, Diffusion, Particle size, Sedimentology.
Identifiers: Turbulent shear flow.

In order to observe the effect of transverse fluid forces on a particle in turbulent shear flow unobscured by a parallel gravity effect, a weak suspension of particles was circulated round a pipe loop with two long, vertical legs. Systematic shifts of concentration were observed in the vertical legs which could be attributed neither to symmetrical diffusion nor entirely to excess normal stress away from the boundary. An explanation of the results is offered based on the simultaneous action of excess normal stress and a lateral force due to circulation round each particle. (Knapp-USGS)
W70-06106

DIFFUSION OF SEDIMENT IN DEVELOPING FLOW,
State Univ. of New York, Buffalo. Dept. of Engineering and Applied Science.
Robert P. Apmann, and Ralph R. Rumer, Jr.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7018, p 109-123, January 1970. 15 p, 7 fig, 4 tab, 12 ref, append.

Descriptors: *Sediment transport, *Turbulent flow, *Diffusion, *Hydraulic models, *Mathematical models, Model studies, Vortices, Eddies, Turbulence, Sampling, Suspended load, Roughness (Hydraulic), Mixing.
Identifiers: Eddy diffusion.

The suspension of sediment particles by turbulent eddy diffusion in a nonuniform flow region was studied, using the convective-diffusion equation as a mathematical model. A simplified form of the equation for which mixing characteristics and flow velocities were assumed uniform was found to accurately describe the sediment concentration profiles which had been measured in a 24-ft long flume. Although diffusivities in the nonuniform region tended towards uniformity with downstream distance the vertical diffusive transport rate was related to depth as a power law function. Measured diffusion coefficients were found to depend on the relative roughness of the mobile bed. (Knapp-USGS)
W70-06108

SEDIMENT MEASUREMENT TECHNIQUES: C. ACCELERATED VALLEY DEPOSITS.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7269, p 1157-1166, May 1970. 10p, 1 fig, 2 tab, 11 ref.

Descriptors: *Deposition (Sediments), *Erosion, *Alluvial channels, *Urbanization, *Accelerated erosion, Stream erosion, Sedimentation, Sediment load, Measuring, Surveys, Investigations, Mapping, Valleys, Sediments, Research and development, Instrumentation, Stratification, Data collections, Data processing.
Identifiers: Valley deposits (Sediments).

Cultrually accelerated deposition of sediment in alluvial valleys has been recognized in the U.S. since 1801 or earlier. Such deposition is most common in valleys with drainage areas smaller than a few hundred square miles, where there has been upland gullying, and where substantial proportions of sand were available. The modern sediment deposit may be recognized by texture, color, compaction, distinctive minerals, buried artifacts, or stratification. These deposits are measured using base maps, surveying, boring, mapping, and sampling. Guidance is given in calculating volumes, tabulating, interpreting, and reporting the data obtained. (Knapp-USGS)
W70-06110

MUD VOLCANOES IN NEW ZEALAND,
British Petroleum Company Ltd., Bangkok (Thailand).
M. F. Ridd.
American Association of Petroleum Geologists Bulletin, Vol 54, No 4, p 601-616, April 1970. 16 p, 13 fig, 49 ref.

Descriptors: *Mud, *Volcanoes, *Pore pressure, *Sediments, *Structural geology, Sedimentary structures, Fissures (Geology), Folds (Geology), Geologic control, Hydrogeology, Faults (Geology).
Identifiers: *Mud volcanoes, *New Zealand.

Quiescent and eruptive mud volcanoes are present on the Raukumara Peninsula of New Zeland. They extrude early Tertiary bentonitic mud with a few boulders from beneath a cover of late Tertiary sedimentary rocks, of which the aggregate thickness is about 20,000 ft (6,100 m). The quiescent ones are low cones and mounds of soft mud and they emit saline water and natural gas, mainly methane. Eruptions of the Hangaroa River and Mangaehu Stream mud volcanoes have been violent, and in 1930 the latter threw mud and rocks about 300 ft (92 m) into the air. Other violent disturbances off the east coast are interpreted as submarine mud-volcano eruptions. Neither the pressure of natural gas being formed nor tectonic pressure alone can account for their occurrence, and it is believed, instead, that they are the surface manifestation of abnormally high pore-fluid pressures caused by compaction. If mud volcanoes are an indication of abnormally high pore-fluid pressures, then they may provide a clue to the tectonic history of the areas in which they are found. (Knapp-USGS)
W70-06125

SEDIMENTARY ENVIRONMENT AND SEDIMENTS OF COOK INLET, ALASKA,
Alaska Univ., College. Inst. of Marine Science.
For primary bibliographic entry see Field 02L.
W70-06129

DISPERSAL OF MISSISSIPPI SEDIMENT IN THE GULF OF MEXICO,
Texas A and M Univ., College Station. Dept. of Geology.
David K. Davies, and Richard W. Moore.
Journal of Sedimentary Petrology, Vol 40, No 1, p 339-353, March 1970. 15 p, 16 fig, 2 tab, 20 ref. USGS Contract No 14-08-0001-10866 and Project 15265, Texas A and M.

Descriptors: *Sediment load, *Mississippi River, *Deltas, *Provenance, *Gulf of Mexico, Deposition (Sediments), Sedimentology, Sedimentation, Mineralogy, Dispersion, Stratigraphy, Sampling.

Pleistocene and Recent Mississippi sediments possess a distinctive heavy mineral assemblage which retains its identify between Cairo, Illinois and the Gulf of Mexico Abyssal Plain. Thus this assemblage may be used to trace the Mississippi contribution to the Gulf of Mexico from fluvial, through deltaic, neritic and bathyal, to abyssal environments. Significant changes in the heavy mineral assemblage of sediments in the Gulf are related to source changes and not to the reworking or selective sorting of Mississippi sediments. As a result, three distinct sediment input sources may be recognized for detrital sediments in the Gulf of Mexico Abyssal Plain, (1) The Mississippi, (2) the Rio Grande, and (3) the rivers of northeast Mexico. The Mississippi contribution is dominant and is only replaced by other inputs in the northwest and southwest corners of the abyssal plain. On the Louisiana-Texas Inner Continental Shelf, Mississippi sediment forms a veneer which extends between the present delta and the Sabine River. Dredge samples reveal that underlying sediments were derived from the central Texas rivers to the west, probably during a period of regression which occurred between 10,000 and 7,000 B.P. The interaction of a high zircon content and intense selective sorting in the Inner Continental Shelf sediments has resulted in two areas of zircon enrichment which may be of economic significance. Because of the insensitivity of the heavy mineral assemblage of the Mississippi contribution to processes of selective sorting and reworking, only 200 non-opaque grains from one size fraction of one sample are needed to characterize this contribution. (Knapp-USGS)
W70-06131

SCOUR AND FILL PROCESSES IN A DEEP RIVER HOLE, OHIO RIVER, LOUISVILLE, KENTUCKY,
Kentucky Univ., Lexington.
Bruce R. Moore.
Journal of Sedimentary Petrology, Vol 40, No 1, p 449-455, March 1970. 7 p, 7 fig, 1 plate, 9 ref.

Descriptors: *Scour, *Stream erosion, *Ohio River, Dredging, Sediment transports, Rivers, Floods, Streamflow, Alluvial channels, Erosion, Model studies, Hydraulic models.
Identifiers: Louisville (Ky), Scour holes, Dredge holes.

A deep hole produced in the Ohio River by suction dredging was measured over a period of two years before and after high water periods. The hole did not fill, but scoured slightly deeper after each high water and the walls remained almost vertical. A vortex or circular eddy developed in the surface flow during high water and sediment was removed from the hole and deposited between the hole and the bank. The movement of water and sediment in a model hole in a flume indicated that a vortex mechanism involving a balance of scour and fill is keeping the hole free of sediment during each period of flood. The sequence of sedimentary structures for the model hole included foreset type beds and dune bedding migrating both upstream and downstream. The final structures preserved de-

pend on the relative lengths of the phases of scour and fill and the maximum mean velocity of the stream. (Knapp-USGS)
W70-06132

ACCUMULATION RATES OF MANGANESE IN PELAGIC SEDIMENTS AND NODULES,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
M. L. Bender, Teh-Lung Ku, and W. S. Broecker.
Earth and Planetary Science Letters, Vol 8, No 2, p 143-148, April 1970. 6 p, 3 fig, 2 tab, 19 ref.

Descriptors: *Bottom sediments, *Trace elements, *Manganese, Water chemistry, Geochemisty, Oceans, Clay minerals, Mineralogy, Deposition (Sediments).
Identifiers: Manganese nodules.

Accumulation rates of manganese in sediments of 38 deep-sea cores range from 0.1 to 3.4 mg/cc/1000 yr. Manganese accumulation rates in five nodules range from 0.2 to 1.0 mg/cc/1000 yr. In the North Pacific, manganese is apparently incorporated into sediments in association with clay or a related phase; in other ocean basins, no generalizations can be drawn from the data presented. The similarity between nodule and sediment manganese accumulation rates could be coincidence or could reflect the possibility that nodules and sediments accumulate manganese by the same mechanism. (Knapp-USGS)
W70-06138

PRELIMINARY DETERMINATIONS OF SEDIMENT DISCHARGE IN SAN JUAN DRAINAGE BASIN, ORGANCE AND RIVERSIDE COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
Carl G. Kroll, and George Porterfield.
Geological Survey Open-file Report, December 1969. 28 p, 10 fig, 14 tab, 4 ref.

Descriptors: *Sediment load, *Suspended load, *Bed load, *Urbanization, *California, Sedimentation, Beaches, Water management (Applied), Surveys, Data collections, Hydrologic data, Streams, Streamflow.
Identifiers: San Juan drainage basin (Calif), Orange County (Calif), Riverside County (Calif).

During the 1967 and 1968 water years the mean daily suspended-sediment discharges at the gaging stations on San Juan Creek and its major tributary, Arroyo Trabuco, near San Juan Capistrano, Calif., were 266 tons and 124 tons, respectively. Extrapolated over the 38 years of water-discharge record 1931-68, the mean daily suspended-sediment discharge at the gaging stations was 124 tons at San Juan Creek and 44 tons at Arroyo Trabuco. The mean daily coarse-sediment discharge for the same 38-year period was about 180 tons at San Juan Creek and 6.1 tons at Arroyo Trabuco. The discharge of coarse sediment at the mouth during the same 38-year period was a mean daily value of 200 tons or 56,000 cubic yards per year. Because of urbanization the mean daily coarse-sediment discharge at the beach will be reduced by about 33 percent during the next 30 years, and, depending upon the water-management practices, the reduction may be even greater. (Knapp-USGS)
W70-06144

PREVENTION OF SCOUR AT BRIDGE ABUTMENTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08A.
W70-06166

PROBLEMS OF STABILITY OF STREAMS IN ERODED BEDS AND STABILITY OF THEIR SHAPES,
Nauchno-Issledovatelskii Gidroenergeticheskii Institut, Tiflis (USSR).
N. K. Kereselidze.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B23, p 194-200, 1967. 7 p, 1 fig, 4 ref.

Descriptors: *Stream erosion, *Alluvial channels, *Channel morphology, Dunes, Sand waves, Flow resistance, Model studies, Hydraulic models, Stream stabilization, Erosion control, Hydraulics, Mathematical studies.
Identifiers: Stream stability criteria.

Investigations were carried out to establish criteria of the stability of flows in eroded beds and to determine their flow resistance. The technique applied in these investigations is based on the condition of dynamic stability. Theoretical stability criteria as well as those of the beginning of bed deformation are in good accord with the experimental data. (Knapp-USGS)
W70-06171

THE MEASUREMENT OF TURBULENT VELOCITY FLUCTUATIONS CLOSE TO A BOUNDARY IN OPEN CHANNEL FLOW,
University Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-06172

STOCHASTIC ANALYSIS OF THE AUTO-FORMATION OF A CHANNEL CUT IN INCOHERENT ALLUVIUM,
Institute for Water Resources, Belgrade (Yugoslavia). Dept. of River Research.
Milorad Miloradov.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B13, p 111-117, 1967. 7 p, 5 fig, 1 ref.

Descriptors: *Erosion, *Channels, *Alluvial channels, Scour, Stochastic processes, Channel morphology, Statistical models, Probability, Stream erosion.
Identifiers: Morava River (Yugoslavia).

When cutting a river meander, it is common practice to excavate a narrow channel and leave it to develop by action of the flowing water. The erosion of such a channel can be considered as a stochastic process, the channel cross-section being a random function of time and position. Hence, the theory of one-dimensional monotonic non-decreasing random processes, as developed by P. Todorovic, could be used to describe the probability distribution functions of channel cross-sections evolving in time. Together with the time coordinate, two parameters enter into the probability distribution function, which depend on the flow conditions and can be determined by experimental methods. An example is given referring to the Morava River in Yugoslavia. (Knapp-USGS)
W70-06175

AREAL VARIATIONS OF BED-FORM CHARACTERISTICS IN MEANDERING STREAMS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 02E.
W70-06176

ACOUSTIC DETECTION OF SEDIMENT MOVEMENT.,
Newcastle-upon-Tyne Univ. (England).
P. Johnson, and T. C. Muir.
Journal of Hydraulic Research, Vol. 7, No. 4, p. 519-540, 1969. 22 p, 9 fig, 12 ref, append.

Descriptors: Acoustic equipment, Sedimentation, *Sediment discharge, *Sediment load, *Sediment transport, *Bed load, Foreign research, Sonic waves, *Detection, *Noise, Laboratory tests, Microphones, Test procedures, Streambeds, Hydrology, Theory.
Identifiers: *Acoustic method, *Bedload movement, *Bedload noise detectors, Sonic device, Sonic pickups, Testing equipment, Great Britain.

Laboratory experiments to investigate the relationship between bedload discharge and the intensity and frequency of sound produced by interparticle collision during sediment movement are described. A corresponding theoretical relationship is also derived. For a single size of particle, the frequency of interparticle collision sound extends over a wide spectrum. Bedload discharge in a laboratory channel is estimable from the microphone signal to within plus or minus 35% at a 65% confidence level. Limited field experience indicates that difficulties would be experienced with mixtures of sizes and extraneous noise in rivers. (USBR)
W70-06241

2K. Chemical Processes

THE RELATIONSHIP BETWEEN ENVIRONMENT AND SEDIMENT COMPOSITION (GEOCHEMISTRY AND PETROLOGY) IN THE BIMINI LAGOON, BAHAMAS,
Sheffield Univ. (England). Dept. of Geology.
For primary bibliographic entry see Field 02L.
W70-05913

COLOR OF WATER IN FLORIDA STREAMS AND CANALS,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 07C.
W70-05931

THE CHEMICAL NATURE OF THE ORGANIC MATRIX BELIEVED TO LIMIT WATER PENETRATION IN GRANITIC SOILS,
Nevada Bureau of Mines, Reno. Desert Research Inst.
For primary bibliographic entry see Field 02G.
W70-05957

CHEMICAL INTERACTIONS OF WASTE WATER IN A SOIL ENVIRONMENT,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05C.
W70-06052

A MULTIPLE REGRESSION TECHNIQUE FOR ADJUSTING BACKGROUND VALUES IN STREAM SEDIMENT GEOCHEMISTRY,
Pennsylvania State Univ., University Park. Mineral Conservation Section; and Pennsylvania State Univ., University Park. Dept. of Geochemistry and Mineralogy.
Arthur W. Rose, Eric C. Dahlberg, and M. L. Keith.
Economic Geology, Vol 65, No 2, p 156-165, March-April 1970. 10 p, 4 fig, 3 tab, 17 ref.

Descriptors: *Sediment load, *Water chemistry, *Geochemistry, *Regression analysis, Iron, Trace elements, Manganese, Statistical methods, Provenance, Geology, Pennsylvania, Exploration, Mineralogy, Sampling.
Identifiers: Stream sediment chemistry, Multiple regression, Geochemistry prospecting.

For efficient use of the stream sediment geochemical method in mineral exploration, the reduction of geological and geochemical background 'noise' is desirable, especially for detecting weak anomalies. A multiple regression method for quantifying the effects of differing lithologies in the drainage basin of the sediment and the content of adsorbing iron and manganese oxides in the sediment is described and applied to a survey of 7,500 sq miles in Pennsylvania. The effects of lithology are defined

as the percentage of the area in the drainage basin occupied by each rock type. The total Fe and Mn content is used to estimate Fe and Mn oxide content. Regression equations expressing Zn, Cu, Ni, Co, Cr and V as a function of these factors account for 20 to 70% of the total variance of each element. Iron content is responsible for a large proportion of the variation explained and appears to be a very important parameter in stream sediments. Comparison of the observed values with the predicted values from the regression equation results in a group of anomalous values that appears to be more useful in mineral exploration than a similar group defined simply as values above some arbitrary or averaged background level. (Knapp-USGS)
W70-06124

ROLE OF GRAVITY, TEMPERATURE GRADIENTS, AND ION-EXCHANGE MEDIA IN FORMATION OF FOSSIL BRINES,
Woods Hole Oceanographic Institution, Mass., and Geological Survey, Woods Hole, Mass.
P. C. Mangelsdorf, Jr., F. I. Manheim, and J.M.T.M. Gieskes.
American Association of Petroleum Geologists Bulletin, Vol 54, No 4, p 617-626, April 1970. 10 p, 2 fig, 5 tab, 46 ref.

Descriptors: *Water chemistry, *Groundwater, *Connate water, *Brines, *Ion exchange, Membrane processes, Clay minerals, Mathematical studies, Mathematical models, Geochemistry, Ions, Sediments, Temperature, Gravity, Chromatography, Ion transport.
Identifiers: Brine formation (Geochemistry).

Calculations show that gravitational settling of ions in an isothermal sediment column could produce increases of equilibrium concentrations in pore waters ranging from 1 percent per 100 m depth for chloride to 4 percent per 100 m depth for strontium. The migration of ions in a thermal gradient (Soret effect) would cause minor salt enrichment upward toward the colder pole, but the presence of cation-exchanging particles such as clays would reverse this tendency and cause pumping of salt downward. A model calculation using literature data for the thermal potentials suggests that about 5-percent enrichment in Cl per 100 m depth may occur under steady-state conditions. These mechanisms do not explain the greater enrichments commonly found in subsurface brines, but may modify salt distributions due to other phenomena. (Knapp-USGS)
W70-06126

THE INFLUENCE OF HENRY'S LAW ON BICARBONATE EQUILIBRIA,
California Univ., Berkeley. Dept. of Hydraulic Engineering; and California Univ., Berkeley. Dept. of Sanitary Engineering.
Jerome F. Thomas, and R. Rhodes Trussell.
Journal American Water Works Association, Vol 62, No 3, p 185-187, March 1970. 3 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Water chemistry, *Carbon dioxide, *Equilibrium, *Bicarbonates, Aqueous solutions, Hydrogen ion concentration, Evaporation, Diffusion, Alkalinity.
Identifiers: Bicarbonate equilibrium, Henrys law.

In a closed system, water saturated with sodium bicarbonate maintains a constant pH. But when the water contacts carbon dioxide in air, pH rises. It is possible to determine the ultimate pH of a water when it comes to equilibrium of the carbon dioxide in the atmostphere. The rate controlling steps are the dehydration of carbon dioxide and the diffusion of carbon dioxide out of the aqueous phase. Based on a consideration of Henry's Law, the equilibrium pH of a bicarbonate solution in equilibrium with air concentrations above 50 ppm will increase from an initial value of 8.3 to some higher value consistent with the total alkalinity. (Knapp-USGS)
W70-06133

THE SOLUBILITY OF FERROUS IRON IN CARBONATE-BEARING WATERS,
Notre Dame Univ., South Bend, Ind. Dept. of Civil Engineering; and Harvard Univ., Cambridge, Mass. Dept. of Engineering and Appled Physics.
Philip C. Singer, and Werner Stumm.
Journal American Water Works Association, Vol 62, No 3, p 198-202, March 1970. 5 p, 8 fig, 2 tab, 16 ref, append.

Descriptors: *Water chemistry, *Iron compounds, *Solubility, *Groundwater, *Bicarbonates, Oxides, Equilibrium, Hydrogen ion concentration, Carbonates, Chemical precipitation, Aqueous solutions.

Under reducing conditions in natural waters, as in the bottoms of lakes under conditions of stagnation and in most groundwaters, the stable form of iron is ferrous iron in the + II oxidation state. In waters free of dissolved carbon dioxide, the solubility of Fe (II) is controlled by solid ferrous hydroxide. At pH values below 10.5, ferrous carbonate controls the concentration of Fe (II) in solution. The solubility product of synthetically prepared siderite (porous carbonate) was determined. At 25 deg C and zero ionic strength, pK = 10.24. Groundwaters may be in or near saturation equilibrium with siderite. Bicarbonato and carbonato complexes of Fe (I) are not relevant in most groundwaters; the only species of any significance in carbonate-bearing waters is free ferrous ion. (Knapp-USGS)
W70-06134

ADSORPTION OF COPPER BY CLAY MINERALS, HUMIC ACID AND BOTTOM MUDS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Aquatic Weed Control.
D. N. Riemer, and S. J. Toth.
Journal American Water Works Association, Vol 62, No 3, p 195-197, March 1970. 3 p, 5 tab, 3 ref.

Descriptors: *Adsorption, *Copper compounds, *Clay minerals, *Humic acids, *Bottom sediments, Algicides, Copper sulfate, Limestones, Water chemistry, Mud, Clays, Ponds.
Identifiers: Copper adsorption.

The adsorption of Cu from solution by H-Al forms of kaolinite, illite, montmorillonite and humic acid was studies in the laboratory. The adsorption and release of Cu from three pond sediments were also examined. All of the clay minerals and humic acid used completely adsorbed the small amounts of Cu that are normally used to control algae. Based on the absolute amounts of Cu adsorbed, the clay minerals and humic acid could be arranged in the following descending order: humic acid, montmorillonite, illite, kaolinite. Copper sulfate applications to ponds are fixed by the bottom, and the factors controlling the fixation are nature of clay minerals, clay content, organic matter content and, in cases of calcareous bottoms, the percentage of limestone present. (Knapp-USGS)
W70-06135

ACCUMULATION RATES OF MANGANESE IN PELAGIC SEDIMENTS AND NODULES,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
For primary bibliographic entry see Field 02J.
W70-06138

BORON CONTENTS OF SERPENTINITES AND METABASALTS IN THE OCEANIC CRUST: IMPLICATIONS FOR THE BORON CYCLE IN THE OCEANS,
Woods Hole Oceanographic Institution, Mass.; and Smithsonian Institution, Washington, D.C.
Geoffrey Thompson, and William G. Melson.
Earth and Planetary Science Letters, Vol 8, No 1, p 61-65, March 1970. 5 p, 1 fig, 3 tab, 29 ref. AEC Contract AT (30-1)-2174.

Descriptors: *Water chemistry, *Weathering, *Sea water, *Metamorphic rocks, *Boron, Igneous rocks, Basalts, Clay minerals, Magmatic water, Geochemistry.
Identifiers: Boron cycle (Sea water).

Serpentinization of periodotite rocks in the oceanic crust is accompanied by boron enrichment. Hydrothermally altered basalts in the oceanic crust show no comparable increase in boron. In high-temperature reactions of basaltic rocks and seawater, boron is preferentially partitioned into the liquid phase; basaltic rocks exposed on the ocean floor undergo low-temperature weathering by seawater resulting in the addition of boron. Juvenile boron-containing solutions may be responsible for serpentinization. Such solutions may also be important in maintaining the boron concentration of the oceans, since boron is removed from sea-water both by clay minerals entering the oceans and by alteration of submarine igneous rocks. (Knapp-USGS)
W70-06140

A SUMMARY OF MINERAL AND THERMAL WATERS IN AUSTRALIA,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 02F.
W70-06145

THE MINERAL AND THERMAL WATERS OF THE TERRITORY OF PAPUA AND NEW GUINEA,
Bureau of Mineral Resources, Geology, and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 02F.
W70-06151

SPRINGS OF DEEP SEATED ORIGIN IN TANZANIA,
For primary bibliographic entry see Field 02F.
W70-06152

CARBON DIOXIDE, CARBONIC ACID, AND BICARBONATE ION: PHYSICAL PROPERTIES AND KINETICS OF INTERCONVERSION,
Harvard Univ., Cambridge, Mass.
John T. Edsall.
National Aeronautics and Space Administration Report SP-188, Proceedings of Symposium at Haverford College, Pennsylvania, August 20-21, 1968, p 15-27, 1969. 13 p, 2 fig, 8 tab, 36 ref.

Descriptors: *Carbon dioxide, *Aqueous solutions, *Carbonates, *Bicarbonates, *Water chemistry, Chemical reactions, Ions, Solubility, Thermodynamics.
Identifiers: Carbonic acid, Chemical kinetics.

The structure and certain properties of carbon dioxide, carbonic acid, and the bicarbonate ion are reviewed. The topics discussed include the solubility of carbon dioxide in water and in several other polar and nonpolar solvents and a comparison with other simple molecules, the thermodynamics of the hydration of bicarbonate ion or carbonic acid, and the catalysis of the hydration and dehydration reactions by various inorganic and organic molecules and ions, including copper chelate complexes of peptides and related compounds. Certain unexplained discrepancies among the existing data are pointed out, with particular reference to the true ionization constant of carbonic acid and the rate constants for the hydration and dehydration reactions at various temperatures. (Knapp-USGS)
W70-06153

GEOCHEMISTRY OF SOME TERTIARY AND CRETACEOUS AGE OIL-BEARING FORMATION WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
A. Gene Collins.
Environmental Science and Technology, Vol 1, No 9, p 725-730, September 1967. 6 p, 2 fig, 7 tab, 21 ref.

Descriptors: *Geochemistry, *Brines, *Oil fields, *Mississippi, *Alabama, Hydrogeology, Aqueous solutions, Saline water, Correlation analysis, Chlorides, Ions, Trace elements, Provenance.
Identifiers: Oil field brines, Factor analysis.

The relationships of ions dissolved in some oil-bearing Mississippi and Alabama formation waters, the relationships to their environment, and their origin were studied. The waters were analyzed by methods developed by the Bureau of Mines. Sodium, calcium, magnesium, chloride, bromide, iodide, bicarbonate, and sulfate ions were analyzed. The age of water-bearing rock, the association of all samples with petroleum, and the depth of water-bearing rock were known environmental conditions. Correlations were found for several ions and for some ions and their environment. The bromide ion provided a means to distinguish the Tertiary age waters (low bromide concentration) from the Cretaceous age waters (relatively high bromide concentration). (Knapp-USGS)
W70-06178

SOME COMMENTS ON 'INTEGRATIVE' AND 'SPECIFIC' PROPERTIES OF THE AQUATIC ENVIRONMENT,
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Centre de Recherches Hydrobiologiques.
B. H. Dussart.
Chemical Environment in the Aquatic Habitat, Golterman, H L and Clymo, R S, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, p 24-19, 1967. 3 ref.

Descriptors: *Chemical analyses, *Water chemistry, *Aquatic environments, Limnology, Hydrogen ion concentration, Oxidation-reduction potential, Alkalinity, Analytical techniques, Dissolved oxygen, Density, Conductivity, Environmental factors, Carbonates, Carbon dioxide, Bicarbonates, Photosynthesis, Humic acids, Iron compounds, Hydrogen sulfide, Anions, Cations, Polarographic analysis, Chemical oxygen demand, Equilibrium, Phosphorus compounds.
Identifiers: *Integrative properties, *Specific properties, *Data acquisition, *Data interpretation, Dry residue, Biotic factors, Abiotic factors, Ionic balances, Buffering, Alkaline reserves, Winkler method, Global methods.

Based upon the type of environmental information which they yield, hydrochemical analyses can be classified as integrative (designated by the untranslatable French term, 'global') or as specific. Global properties are influenced by diverse factors, and require for correct interpretation at least partial knowledge of those factors. Global analyses include pH, redox potential (rH), alkalinity, oxygen, chemical oxygen demand (COD), density, dry residue, and electrical conductivity. Factors influencing pH, rH, alkalinity, oxygen, and COD are considered here in some detail. Specific or special methods, which may consider only a single element, provide exact information regarding environmental composition and may even make possible the establishment of ionic balances, but do not provide information bearing on dyamic characteristics of the chemical species in the environment. Since, as is well known for iron and phosphorus, not all molecular forms of an element take part in all biological or chemical processes, an aim of limnological research should be to distinguish between possible pathways. Ecologically considered, the two sorts of methods must be chosen well and used in a complementary fashion to provide better understanding of interrelationships between the biotic and abiotic worlds as they function in time. (See W70-04821) (Eichhorn-Wisconsin)
W70-06216

AUTOMATED ANALYSIS FOR NITRATE BY HYDRAZINE REDUCTION,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Engineering Section.
For primary bibliographic entry see Field 05A.
W70-06219

THERMODYNAMICS OF BIOLOGICAL SYNTHESIS AND GROWTH,
Standford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W70-06234

THE PHOTOSYNTHETIC PIGMENTS OF LAKE SUPERIOR PERIPHYTON AND THEIR RELATION TO PRIMARY PRODUCTIVITY,
Minnesota Univ., Minneapolis. Water Resources Research Center.
Lee W. Stokes, Theodore A. Olson, and Theron O. Odlaug.
Available from the Clearinghouse as BP-191 523, $3 in paper copy, 65 cents in microfiche. University of Minnesota Graduate School, Water Resources Research Center, Minneapolis, WRRC Bulletin 18, January 1970. 150 p. 110 fig, 26 tab, 168 ref. 3 plates, 2 appendices. OWRR A011-MINN (9).

Descriptors: *Lake Superior, *Eutrophication, *Periphyton, Photosynthesis, Pigments, Primary productivity, Light intensity, Chlorophyll, Respiration.
Identifiers: Shade tolerance, Light adaptation, Epilithic periphyton.

The biomass, community structure, and photosynthetic activity of epilithic periphyton of the north shore of Lake Superior were investigated during the summers of 1966, 1967, and 1968. Pigment ratios indicated predominance of Chrysophyta. The standing crop on oven-dry basis was 156 gram/square meter. Net production in 1967 averaged 1.01 gram carbon fixed per square meter/day. Daily increment of chlorophyll was 0.57 milligram/square meter. Up to 40 foot depth, periphyton can be 5 to 6 times as important in primary production as the phytoplankton. Q-sub-10 for conditioned samples at light saturation ranged from 1.24 to 2.48. The compensation point varied from 80 to 130 foot-candles. The efficiency of energy utilization by periphyton was 0.82, a value typical for algal communities. It is assumed that periphyton will provide a baseline for estimating the advance of eutrophication of Lake Superior. (Wilde-Wisconsin)
W70-06238

2L. Estuaries

THE RELATIONSHIP BETWEEN ENVIRONMENT AND SEDIMENT COMPOSITION (GEOCHEMISTRY AND PETROLOGY) IN THE BIMINI LAGOON, BAHAMAS,
Sheffield Univ. (England). Dept. of Geology.
Roger Till.
Journal of Sedimentary Petrology, Vol 40, No 1, p 367-385, March 1970. 19 p, 5 fig, 10 tab, 23 ref.

Descriptors: *Geochemistry, *Mineralogy, *Lagoons, *Islands, *Reefs, Deposition (Sediments), Chemical precipitation, Chemical analysis, Water chemistry, Statistical methods, Correlation analysis, Sedimentology.
Identifiers: *Bimini.

Surface sediments from the Bimini Lagoon were analyzed for their major element content (CaO, SrO and MgO), minor element content (Si, Al, Fe, Ba, Cr and Mn), mineralogy (aragonite, high and low magnesium calcite) and petrographic constituents (grain size, intraclasts, pellets, oolites, skeletal material and mud content). The overlying waters were also analyzed. The data were analyzed statistically to discover controls on overall geochemical variation. Linear product moment correlation coefficients were calculated for all variable pairs. A correlation matrix was generated and used to identify covarying groups of variables. The physical environment in terms of water quietness (rather than the chemical environment) is shown to govern the organic and inorganic phase constituents of the sediments; these in turn govern the bulk chemistry. Correlation analysis was repeated for the sample population from each of the three water masses in the lagoon. The same basic control of water quietness is operative in each area. A simple analysis of variance for the sample groups from each water mass showed that the sediments from three areas of different salinity in the lagoon are also significantly different in bulk constitution. But the salinity (and hence chemistry) of the waters is not simply related to the sediment composition; for the three masses are also distinct in terms of physical environment and it is this which is reflected in the mean sediment composition. (Knapp-USGS)
W70-05913

STUDY OF ESTUARINE POLLUTANT AND WATER QUALITY DISTRIBUTION IN THE NEW YORK CITY -- NEW JERSEY METROPOLITAN AREA.
Quirk, Lawler and Matusky, New York.
For primary bibliographic entry see Field 05B.
W70-05937

TEMPERATURE, SALINITY, AND TRANSPARENCY OBSERVATIONS, COASTAL GULF OF MAINE, 1962-65,
Bureau of Commercial Fisheries, West Boothbay Harbor, Maine. Biological Lab.
Joseph J. Graham.
Available from the Clearinghouse as PB-189 119, $3.00 in paper copy, $0.65 in microfiche. U.S. Fish and Wildlife Service Data Report no. 42, Wash, DC, Jan 70. 45 p.

Descriptors: *Coasts, Marine fisheries, Environmental effects, *Herrings.
Identifiers: Clupea harengus harengus Linnaeus.

Staff members of the Bureau of Commercial Fisheries Biological Laboratory, Boothbay Harbor, Maine, measured water temperature, salinity, and transparency to study the environment of immature herring (Clupea harengus harengus Linnaeus) in the coastal Gulf of Maine from 1962 through 1965. The observations were plotted for 11 cruises. Temperature usually increased and salinity decreased from east to west along the coast. These trends were complicated vertically by less tidal mixing and larger river discharges in the west, causing there a more pronounced vertical stratification than in the east. Transparency usually increased from inshore to offshore, and at times the distribution of the transparency isolines agreed closely with those for temperature.
W70-05963

SHORE EROSION BY STORM WAVES,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
Joseph M. Caldwell.
Available from the Clearinghouse as AD-699 407, $3.00 in paper copy, $0.65 in microfiche. Miscellaneous paper No 1-59, April 1959. 19 p, 8 figs.

Descriptors: *Beach erosion, *Waves (Water), *Storms, Hurricanes, Stabilization, Control, *Dunes, Beaches.

In connection with its mission of developing hurricane protection plans for the Atlantic and Gulf shores of the United States, the Corps of Engineers, Department of the Army, has need to know the magnitude of shore erosion which can be expected from hurricane wave attack. To partially fill this need, the information on storm wave erosion available in the files of the Beach Erosion Board is summarized in this report.
W70-05965

WAVE FORCES ON PILES: A DIFFRACTION THEORY,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
R. C. MacCamy, and R. A. Fuchs.
Available from the Clearinghouse as PB-116 606, $3.00 in paper copy, $0.65 in microfiche. Technical memorandum No 69, Dec 1954. 21 p, 2 tabs, 5 refs.

Descriptors: *Beach erosion, *Waves (Water), *Piles (Foundations), *Pile foundations, Harbors, Shore protection, Coastal structures.

Although circular piling is a much-used structural element in shore protection, harbor, and other maritime structures, only recently have significant advances been made toward gaining a quantitative understanding of the forces developed by wave action against piling. The present report deals with this subject.
W70-05967

REPORT ON BEACH STUDY IN THE VICINITY OF MUGU LAGOON, CALIFORNIA,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
D. L. Inman.
Available from the Clearinghouse as AD-699 392, $3 in paper copy, 65 cents in microfiche. Technical memorandum No 14, Mar. 1950, 52 p., 27 figs.

Descriptors: Beach erosion, Waves (Water), Ocean waves, Stabilization, Tides, Topography, California.
Identifiers: Mugu Lagoon (Calif).

Investigation and study indicate that the beaches and sand spits bordering Mugu Lagoon are not stable, and that improvements in this area should be undertaken with caution. Any changes will tend to upset the natural beach equilibrium and in some cases may result in further depletion and erosion of the narrow spits bordering the lagoon. Longshore current studies showed that the complex bottom topography over the Mugu Submarine canyon heads gives rise to currents that may be opposed in direction to the currents along the straight beach northwest of Mugu. The angle of wave approach and the 'piling up' of water at wave convergence points appear to be the controlling factors in determining the direction of flow of the longshore currents. The effect of (1) spring tides, (2) high waves, and (3) direction of the longshore transport of sand on the stability of the spits bordering Mugu Lagoon is discussed.
W70-05969

HURRICANE SURGE PREDICTIONS FOR CHESAPEAKE BAY,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
Charles L. Bretschneider.
Available from the Clearinghouse as AD-699 408, $3 in paper copy, 65 cents in microfiche. Miscellaneous Paper No 3-59, Sept. 1959, 59 p, 19 refs, 7 tabs, 20 figs.

Descriptors: *Beach erosion, *Waves (Water), Beaches, *Hurricanes, *Surges, Tides, Ocean waves, Forecasting, Design, Mathematical models.
Identifiers: *Chesapeake Bay.

The report presents a comprehensive investigation of hurricane surge problems for the Chesapeake Bay area. Methods and techniques are presented, and are calibrated with available surge data, so that the computational procedures result in reasonable estimates of maximum hurricane surge for design purposes. It is believed that the final results given in this report can only be refined by use of additional hurricane surge data, suitable for furthering the present investigation. Such additional hurricane surge data are not available at present, but might become available from future hurricanes affecting the Chesapeake Bay area. In addition theoretical studies, the formulas and techniques of which must also be calibrated, performed in the future, might tend to refine the surge results presented in this report.
W70-05970

THE SOURCE, TRANSPORTATION, AND DEPOSITION OF BEACH SEDIMENT IN SOUTHERN CALIFORNIA,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
John W. Hardin.
Available from the Clearinghouse as PB-103 919, $3 in paper copy, 65 cents in microfiche. Technical Memorandum No 22, Mar. 1951, 129 p.

Descriptors: *Beach erosion, *Beaches, *Sands, *Sediment transport, Waves (Water), Ocean waves, California.

Beach studies are of importance as a basis for engineering design of harbors, shore protective works, and other commercial and recreational facilities. Geologists find modern beaches to be of particular interest as sources of information about sedimentary processes and as clues to the origin of certain ancient deposits. This thesis is the result of work undertaken for the Los Angeles District Engineer Office and of graduate work at the University of California, Los Angeles. It deals with the source, transportation, and deposition of beach sands along the southern California coast from Carpinteria to Point Fermin.
W70-05971

HURRICANE SURGE PREDICTIONS FOR DELAWARE BAY AND RIVER,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
Charles L. Bretschneider.
Available from the Clearinghouse as AD-699 904, $3 in paper copy, 65 cents in microfiche. Miscellaneous paper No 4-59, Nov. 1959, 53 p. 17 refs, 4 tabs, 21 figs.

Descriptors: *Beach erosion, *Waves (Water), Beaches, *Hurricanes, *Surges, Tides, *Ocean waves, Breakwaters, Mathematical models, Design, Delaware river, Forecasting.
Identifiers: Delaware River.

Surge heights have been computed for various locations for Delaware Bay and River for two hypothetical hurricanes. Hurrican 'A' is the same as the September 14, 1944, Cape Hatteras hurricane transposed to the Delaware Bay area to produce maximum surge entering that bay and propagating to various points of interest (See HUR 7-20). Hurricane 'B' is exactly the same in all respects as hurricane 'A' except that all wind speeds are greater by 5 mph. The stress parameter used was k=3.0 x 0.000001. A table summarizes computed surge elevations.
W70-05973

BACTERIAL POPULATION DENSITIES (HETEROTROPHS) IN THE WATER COLUMN OF THE SOUTHERN AND INDIAN OCEANS,
Akademiya Nauk SSSR, Moscow. Institut Mikrobiologii.
A. E. Kriss, I. E. Mishustina, and M. N. Lebedeva.
Microbiology, Vol 38, No 3, p 430-435, 1969. 3 fig, 2 tab, 10 ref.

Descriptors: *Bacteria, *Population, *Density, *Columns, *Water, *Oceans, Indian Ocean, Microorganisms, Stratification, Tropical regions, Latitudinal studies, Yeasts, Arctic Ocean, Pacific Ocean, Sampling.
Identifiers: *Heterotrophs, *Southern Ocean, Fremantle (Australia), Mirnyy (Antarctica), Africa, Prydz Bay (Antarctica), Ganges estuary (Pakistan), Drake's Bay (Antarctica), Sunda, Philippines, Coral Sea, Bacterium agile, Kamchatka (USSR), Kurile Island (USSR), Gulf of Bengal (India).

Microflora of the Southern Ocean from Fremantle, Australia, to Mirnyy, Antarctica; from Antarctica to Africa along 20 degrees east longitude; in Prydz Bay, Antarctica, and in Indian Oceans's western equatorial zone was studied. Bacteria in the water column fluctuated from zero to tens, and occasional readings showed hundreds of bacteria per 50 milliliters of water. In western Indian sector (Southern Ocean) bacterial population density was less than in eastern and the equatorial zone population exceeded that in high latitudes. In the section from Australia to Antarctica, microbiological tracing detected four water layers of equatorial-tropical origin below ocean surface. A layer of Antarctic origin was widest from Antarctica to 50 degrees south latitude. Influence of Antarctic water was sharper from Antarctica to Africa along 20 degrees east longitude, filling nearly the entire ocean column south of 55 degrees south latitude. Waters of equatorial-tropical origin were found here only as isolated islands. In sections from Australia to Antarctica and Antarctica to Africa, the water layer topography of equatorial-tropical origin was consistent. Considerable similarity appeared in the Southern Ocean hydrological structure from Australia to Mirnyy and in corresponding parts from Mirnyy to Ganges estuary. (Jones-Wisconsin)
W70-05985

ON THE NUTRITION AND METABOLISM OF ZOOPLANKTON. I. PRELIMINARY OBSERVATIONS ON THE FEEDING OF THE MARINE COPEPOD, CALANUS HELGOLANDICUS (CLAUS),
Marine Biological Association of the United Kingdom, Plymouth (England). Lab.
E. D. S. Corner.
Journal of the Marine Biological Association of the United Kingdom, Vol 41, p 5-16, 1961. 1 tab, 36 ref.

Descriptors: *Nutrient requirements, *Metabolism, *Zooplankton, *Marine animals, *Copepods, Light intensity, Sea water, Organic matter, Lipids, Proteins, Carbohydrates, Respiration, Temperature, Food chains, Phytoplankton, Diatoms, Chlamydomonas, Flow rates, Oxygen requirements.
Identifiers: *Calanus helgolandicus (Claus), Calanus finmarchicus (Gunnerus), Flagellates, Assimilation, Ditylum brightwellii, Chlamydomonas, Particulate matter, Plymouth Sound (England), Dark, Dunaniella, Skeletonema, Uptake, Filtering rate.

Measurements were made of the quantity and type of food assimilated by adult female marine copepod Calanus helgolandicus (Claus) during the summer months. Animals kept in the drak at 10C under a continuous flow of 'outside' Plymouth sea water (0.95 to 2.50 milligrams insoluble organic material/liter) removed 26.0 to 66.5 micrograms/day per Calanus, 74 to 91% actually digested. Volumes of sea water filtered daily varied between 10.0 and 36.0 milliliters/animal, averaging 21.5. Animals preferentially selected a diet high in organic content from the particulate food available, digesting average daily quantities of 18.1 micrograms carbohydrate, 6.5 micrograms lipid, and 2.7 micrograms protein. Average amount of food digested daily accounted for 25.3% of dry weight and was equivalent to an average respiration rate of 26.5 microliters oxygen/animal per day, which adequately accounts for the highest values reported by others for C finmarchicus (Gunnerus) kept under similar conditions of light and temperature. These results, providing direct evidence that Calanus obtains the bulk of its food from particulate material present in the sea, are discussed with special reference to Putter's hypothesis. (Jones-Wisconsin)
W70-05997

MARINE BENTHIC DIVERSITY: A COMPARATIVE STUDY,
Woods Hole Oceanographic Institution, Mass.
Howard L. Sanders.
The American Naturalist, Vol 102, No 925, p 243-282, 1968. 18 fig, 3 tab, 44 ref.

Descriptors: *Benthos, *Marine animals, Ecological distribution, Sampling, Methodology, Oceans, Latitudinal studies, Depth, Temperature, Salinity, Stability, History, Estuarine environment, Indian Ocean, Continental shelf, Continental slope, New England, Methodology, Physiological ecology, Biological communities, Geologic time, Mathematical models.
Identifiers: *Diversity measurements, *Composition, Abyssal rise, Rarefaction method, Polychaete-bivalve fraction, Lake Baikal (Siberia), Stability-

time hypothesis, Tropical shallow waters, Deep sea waters, Outer continental shelf, Boreal shallow water, Tropical estuary, Boreal estuary.

Methodology is presented for measuring marine benthic diversity based on rarefaction of actual samples. Application of this technique enables a within-habitat analysis of the bivalve and polychaete components of soft-bottom marine faunas differing in latitude, depth, temperature, and salinity. The resulting diversity values were rigidly correlated with the physical stability and past history of these environments. A stability-time hypothesis was invoked to fit these findings, and, with this hypothesis, predictions made diversities present in certain other environments as yet unstudied. The time component of stability-time hypothesis is best illustrated with lakes; Lake Baikal (Siberia), formed either about 1 or 30 million years ago, is characterized by a highly diverse fauna. The two types of diversity, based on numerical percentage composition and on specie numbers, were compared and shown to be poorly correlated. Data indicated species number is the more valid diversity measurement. The rarefaction methodology was compared with a number of diversity indices using identical data; many of these indices were markedly influenced by sample size. Good agreement was found between the rarefaction methodology and the Shannon-Wiener information function. (Jones-Wisconsin)
W70-05998

EFFECTS OF SURFACE RUNOFF AND WASTE DISCHARGE INTO THE SOUTHERN SECTOR OF KANOEHE BAY: JANUARY-APRIL 1968,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 05C.
W70-06099

SEDIMENTARY ENVIRONMENT AND SEDIMENTS OF COOK INLET, ALASKA,
Alaska Univ., College. Inst. of Marine Science.
G. D. Sharma, and D. C. Burrell.
American Association of Petroleum Geologists Bulletin, Vol 54, No 4, p 647-654, April 1970. 8 p, 5 fig, 1 tab, 8 ref.

Descriptors: *Sediments, *Sediment transport, *Inlets (Waterways), *Alaska, Sedimentary structures, Deposition (Sediments), Tides, Tidal effects, Currents (Water), Estuaries, Erosion, Scour, Bed load, Suspended load, Turbulence, Ice, Glaciers, Topography.
Identifiers: Cook Inlet (Alaska).

The distinctive sedimentary environment of Cook Inlet, south-central Alaska, may be attributable in part to a unique combination of the gross morphologic and climatologic characteristics of the area. The sediments consist predominantly of cobbles, pebbles, and sand with minor admixtures of silt- and clay-size material. Three sedimentary facies are suggested on the basis of the detailed grain-size distributions. The boundaries of each facies are very well defined. During the summer months, large quantities of glacially derived sediment are added to the upper reaches of the inlet. Strong currents prevent early deposition of most of the silt and clay which are transported seaward toward the Forelands morphologic constriction. In this area intense tidal flushing removes almost all material of less than gravel size. The rate of sediment supply to the inlet is minimal during the extended winter season, and sediments are reworked predominantly by ice rafting. Much of the material probably is deposited initially in the area adjacent to the Forelands. (Knapp-USGS)
W70-06129

BORON CONTENTS OF SERPENTINITES AND METABASALTS IN THE OCEANIC CRUST: IMPLICATIONS FOR THE BORON CYCLE IN THE OCEANS,
Woods Hole Oceanographic Institution, Mass.; and Smithsonian Institution, Washington, D.C.
For primary bibliographic entry see Field 02K.
W70-06140

THE GEORGES RIVER HYDRAULIC, HYDROLOGIC AND RECLAMATION STUDIES,
New South Wales Univ., Kingston (Australia).
C. H. Munro, D. N. Foster, R. C. Nelson, and F. C. Bell.
New South Wales University Water Research Laboratory Report No 101, December 1967. 32 p, 32 fig, 20 ref, 4 append.

Descriptors: *Estuaries, *Water resources development, *Land development, *Wetlands, *Flood control, Marshes, Urbanization, Hydrology, Aquatic environment, Multiple-purpose projects, River basin development, Environmental effects, Environmental engineering.
Identifiers: New South Wales (Australia).

Reclamation of inlets along the foreshores of the Georges River Estuary, New South Wales, Australia has been proposed. Hydraulic studies have shown that the proposed works will affect the river regime to some extent. Tidal velocities will be reduced by up to 10 percent leading to siltation of the river channels. A maximum reduction of 10 percent in the cross sectional areas of the river channels is forecast if all the proposed works are carried out. The proposed works will also increase the pollution problem to some extent by reducing the tidal storage available for dilution of contaminants introduced into the river. As the river regime will be upset by reclamation works, it is considered unwise to proceed with large-scale schemes, such as that proposed for Lime Kiln Bay, without first carrying out a study of the ultimate reclamation requirements for the estuary. (Knapp-USGS)
W70-06177

THE SEA, (VOL 2).

Hill, M N, general editor. New York, John Wiley and Sons, 1965. 554 p.

Descriptors: *Oceanography, *Reviews, *Sea water, *Chemical properties, Oceans, Estuaries, Physiological ecology, Radioactivity, Radioisotopes, Mixing, Ocean currents, Chemical analysis, Instrumentation, Fertility, Sampling, Organic compounds, Thermometers, Phytoplankton, Bioassays, Marine fisheries, Geographical regions, Food chains, Biological communities, Submarines, Sea level, Analytical techniques, Measurement.
Identifiers: *Compendia, *Chemical composition, *Comparative oceanography, *Descriptive oceanography, Biological oceanography, Micronutrients, Gyropendulum, Equatorial currents, Eastern boundary currents, Drogues, Floats, Deep currents, Deep seas, Fishery dynamics, Biological species, Water masses, Bathyscaphs, Mooring, Anchoring.

This compendium, the second volume of a treatise on oceanography, constitutes a source of detailed discussions regarding chemical and biological processes occurring in marine environments. Topical coverage, by chapters, of its first section, on chemistry, includes: oceans as a chemical system; influence of organisms on composition of seawater; artificial radioactivity in sea; radioisotopes and large-scale oceanic mixing; chemical instrumentation; water sampling and thermometers. Second section considers oceanic fertility, covering: productivity, definition and measurement; organic regulation of phytoplankton fertility; bioassay of trace substances. Third section, on currents, comprises: equatorial current systems; eastern boundary currents; the southern ocean; deep-current measurements with neutrally buoyant floats; drogues and neutral buoyant floats; estuaries; applications of gyropendulum. Fourth section, on biological oceanography, includes: geographic variations in productivity; biological species, water masses and currents; communities of organisms; theory of oceanic food-chain relationships; analysis and interpretation of fishery dynamics. Section five, oceanographic miscellanea, covers: seasonal changes in sea-level; bathyscaphs and deep submersibles in oceanography; deep-sea anchoring and mooring. The volume, which is the product of 29 contributors, contains a preface by the general editor, and author and subject indices. (See also W70-06211) (Eichhorn-Wisconsin)
W70-06210

II. FERTILITY OF THE OCEANS. 7. PRODUCTIVITY, DEFINITION AND MEASUREMENT,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
E. Steemann Nielsen.
The Sea (Vol 2), M N Hill, general editor, New York, John Wiley and Sons, p 129-164, 1965. 20 fig, 3 tab, 66 ref.

Descriptors: *Productivity, *Measurement, *Sea water, Photosynthesis, Phytoplankton, Transparency, Trophic levels, Standing crop, Water pollution effects, Analytical techniques, Sampling, Atlantic Ocean, Chlorella, Respiration, Chlorophyll, Physiological ecology, Coccolithophores, Diatoms, Dinoflagellates.
Identifiers: *Definitions, Photobiology, Radiocarbon uptake techniques, Light-dark bottle techniques, Nutrient consumption techniques, Oxygen production techniques, Irradiance, Gross primary production, Net primary production, Isotope discrimination, Depth effects, Seasonal effects, Tropical seas, Norwegian Sea, Sargasso Sea, Arctic seas, South China Sea, Iceland, Kattegat.

Marine production is more precisely defined in terms of two narrowly restricted concepts: gross primary production which is rate of real photosynthesis; and net primary production, equalling gross primary production less rate of algal respiration. 'Production' of animal matter represents transfer of matter or energy from one trophic level to another. Concept of standing stock (= standing crop) is not synonymous with production, although it is often a usefu l index of marine productivity. Primary production may be estimated from consumption of carbon dioxide, from oxygen production in light and dark bottles, and from radiocarbon uptake. In radiocarbon technique, dark fixation of carbon and isotope discrimination constitute potential sources of error for which corrections may be required. Water color and transparency, defined in terms of depth of photosynthetic layer, yield useful estimates of production in areas of open ocean not subject to coastal influences. Significance of single determinations of production vary according to extent of temporal and seasonal variations, and horizontal movement of water masses. Because photosynthesis is inhibited at high light levels, production at sea surface may be less than a maximum occurring deeper, and oscillations of production rate, due to variations in irradiance, tend to be damped out. (See W70-06210) (Eichhorn-Wisconsin)
W70-06211

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

THE ELECTROSORB PROCESS FOR DESALTING WATER,
Marquardt Co., Van Nuys, Calif.
Allan M. Johnson, A. Wayne Venolia, Robert G. Wilbourne, and John Newman.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price 40 cents. Office of Saline Water Research and Development Progress Report No 516, March 1970. 31 p, 26 fig, 2 tab, 16 ref. OSW Contract No 14-01-0001-1444.

Descriptors: *Desalination processes, *Ion transport, *Adsorption, *Electrochemistry, Separation

techniques, Electrolysis, Electrodialysis, Electrical studies.
Identifiers: Electrosorb desalination.

The theory of potential modulated ion sorption is discussed in terms of a capacitance model. The experimental program is described, and review of the economic feasibility of the method is presented. A theory was developed which is consistent with experimental evidence. Experimental work demonstrated the effectiveness of the system when operating on feedwaters composed of the principal ionic species that are commonly found in natural waters. Preliminary costs studies indicate that reasonable costs can be expected, especially for the improvement of waters of relatively low salinity, provided that adequate durability of the electrodes can be attained. (Knapp-USGS)
W70-06121

DETERMINATION OF THE SURFACE AND COLLOIDAL CONDITIONS WHICH CAN LEAD TO HIGH SALT REJECTION REVERSE OSMOSIS POLYMER MEMBRANES,
Philco-Ford Corp., Newport Beach, Calif.
Wayne J. Subcasky, and Gilbert Segovia.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402, Price $1.25. Office of Saline Water Research and Development Progress Report No 466, October 1969. 135 p, 41 fig, 30 tab, 50 ref. OSW Contract No 14-01-0001-1317.

Descriptors: *Desalination processes, *Reverse osmosis, *Membranes, Membrane processes, Permeability, Plastics, Semipermeable membranes, Laboratory tests.
Identifiers: Membrane evaluation, Salt rejection.

Detailed descriptions are given of the facilities used to prepare both flat sheet and tubular reverse osmosis membranes and to determine their performance characteristics. Correlations are given for the surface tension lowering of characteristic feed solutions and for the reduction in water and salt fluxes through membranes with the concentration of additive in the feed solution. Correlations were found, by means of infrared spectroscopy, between the extent of hydrogen bonding of water to hydrophilic groupings in various additives and the effectiveness of the additives in improving desalination characteristics. Measurements were made of (1) viscosity, turbidity, and optical depolarization parameter of solutions of various concentrations of cellulose acetate in acetone; (2) the viscosity of various solutions of cellulose acetate in acetone-water and acetone-formamide mixtures; and (3) the gravimetric swelling ratio, turbidity, turbidity ratio, and distilled water transport rate of membranes cast from various solutions of cellulose acetate in acetone-water, in acetone-formamide, and acetone-Mg chlorate mixtures. Performance parameters were measured for membrane casts from solutions of cellulose acetate in acetone, in dioxane, in acetonitrile, and in dimethylformamide solvents. (Knapp-USGS)
W70-06148

3B. Water Yield Improvement

SWAMPY FORESTS AND BOGS OF SIBERIA,
N. I. Plyavchenko.
Portions of this document are not fully legible. Trans. of Zabolochennye Lesa i Bolota Sibiri. Academy of Sciences, Moscow, 1963. Army Foreign Science and Technology Center Technical Translation. FSTC-HT-23-310-70. December 1969, 215 p.

Descriptors: *Tundra, *Swamps, *Bogs, *Succession, Ecology.
Identifiers: *Peat bogs, *Siberia.

The lands of the forest reserves of Siberia and the Far East include over 110 million hectares of swamps and very swampy forest covered lands, the dendritic vegetation of which is not considered timber. This amounts to about 79% of the entire areas of swamp and swampy lands of the Soviet Union, accounted for by forestry statistics. The present thematic collection includes data almost entirely pertaining to the territory of Siberia. In it examination is made of the specific features of swamp formation, types of swamp and swampy forests in various geographical regions. The results of studies of the structure and growth of the root systems of dendritic plants in swamps of various types are presented; the characteristics of the composition and seasonal dynamics of the soil fauna and microflora are given and the interaction between earth worms and the microflora of swampy forest soils are described. The characteristic of the soil fauna of drained forest soils is given on the basis of investigations performed on the drained units of the Siverskiy Forestry Farm in the Leningradskaya where the drainage reclamation works have a history of more than half a century.
W70-06034

EFFECT OF EROSION - CONTROL LAND TREATMENT ON FLOW FROM AGRICULTURAL WATERSHEDS,
Agricultural Research Service, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-06040

ECOLOGICAL IMPLICATIONS OF RIPARIAN VEGETATION MANAGEMENT,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
C. J. Campbell.
Journal of Soil and Water Conservation, Vol 25, No 2, p 49-52, March-April 1970. 4 p, 3 fig, 17 ref.

Descriptors: *Water yield improvement, *Environmental effects, *Evapotranspiration control, *Clear-cutting, *Forest management, Land management, Runoff, Streamflow, Topography, Vegetation effects, Watershed management, Riparian plants.
Identifiers: Riparian vegetation.

Managing riparian vegetation in the Southwest to increase water yield may require selective clear-cutting rather than complete removal of riparian plants to maintain a biological balance and thus prevent thermal pollution, channel erosion, and destruction of aquatic and wildlife habitats. To properly evaluate costs and benefits, managers must also consider costs of initial vegetation removal plus costs of replacement with other life forms. If in the future we consider water a natural resource most beneficial to cities located many miles downstream, then, as demand increases, prices of water will rise. This, in turn, will justify more sophisticated supply and transport systems. Perhaps then it will be feasible and in fact necessary, to bypass some stream channels completely by piping the water directly from the watershed. (Knapp-USGS)
W70-06103

WEATHER MODIFICATION AS AN UNCERTAIN INNOVATION,
For primary bibliographic entry see Field 06B.
W70-06258

3C. Use of Water of Impaired Quality

RELATIONSHIP OF WATER QUALITY AND SOIL PROPERTIES TO SEEPAGE PROBLEMS,
Seepage Control Inc., Phoenix, Ariz.
J. Harlan Glenn.
Proceedings, Seepage Symposium, Second, March 25-27, 1968, Phoenix, Arizona, U.S. Dept. of Agriculture, Agricultural Research Service ARS 41-147: April 1969, p 1-7, 11 fig, 7 ref.

Descriptors: *Seepage, *Water types, *Linings, *Water quality, *Soil properties, Leakage, Reservoir leakage, Canal seepage, Canal linings, Concrete-lined canals, Canals, Dams, Water works, Water storage, Clays, Soil sealants, Mineralogy, Salinity, Salt balance, Soil tests, Soil compaction, Soil stabilization, Soil structure, Irrigation, Arizona, South Dakota, Water loss.
Identifiers: *Environmental chemistry.

Although permanent linings are used more and more frequently in water works construction, soil linings continue to be used in major operations such as large reservoirs. Unfortunately, rate of actual seepage loss in the field is often 5 to 10 times the amount which laboratory soil tests predicted. One of the primary causes of seepage loss is the effect of water quality on the soil lining. This fact is widely recognized in the irrigated agriculture and petroleum industries, but this knowledge is seldom put to use in water-works design. Water which contains a low ratio of sodium to calcium plus magnesium usually affects any clay soil by increasing its permeability. Thus, if laboratory analysis of soils does not utilize water with the same mineral content as that found in the field, the resulting data are not realistic. Specific examples from Arizona and South Dakota illustrate the problems which may be encountered and the variety of possible solutions that are available. Much more experimentation in the field of environmental chemistry is necessary. (See W70-06010). (Carr-Arizona)
W70-06009

WATER AND POLLUTION CONTROL IN THE IRON AND STEEL INDUSTRY, WITH SPECIAL REFERENCE TO THE SOUTH AFRICAN IRON AND STEEL INDUSTRIAL CORPORATION,
Pretoria Steel Works (South Africa).
For primary bibliographic entry see Field 05D.
W70-06088

3D. Conservation in Domestic and Municipal Use

MUNICIPAL CORPORATIONS - GENERAL POWERS (CONTROL OF WATER SUPPLY AND WATERCOURSES).

Ohio Rev Code Ann secs 715.08, 715.15, 715.19, 715.31, 715.32, 715.40, 715.41, 715.47 (Page 1953).

Descriptors: *Ohio, *Cities, *Water supply, *Drainage, Legislation, Municipal water, Waste disposal, Waste water treatment, Water works, Canals, Drains, Ditches, Streams, Docks, Piers, Cost-benefit theory, Bridges, Regulation, Standing waters, Surface waters, Natural flow, Obstruction to flow.
Identifiers: Ferries.

Any municipal corporation may provide for a water supply and water works. Any municipality may construct or improve any canal or watercourse within or contiguous to its boundaries. Public wharves, landings, piers, docks, bridges and viaducts may also be constructed, improved and regulated and the rates for use of such facilities established. Municipalities have exclusive authority over the establishment, regulation and licensing of ferries. They may establish, maintain and regulate sewage works and treatment plants. Municipalities may drain stagnant water from any property within their boundaries, with the owner assessed in proportion to the benefit to the land. They may also fill or drain any land, remove all obstructions to the natural flow of any watercourse and improve inadequate drains, or direct the owner to do so. If the owner refuses, the municipality may do the work required and recover the cost by suit in any court. (Douberley-Florida)
W70-06015

WATER SUPPLY DISTRICTS: METROPOLITAN (PURPOSE, CREATION AND AUTHORITY).

Mo Ann Stat secs 247.230 thru 247.670 (1959).

Descriptors: *Missouri, *Water supply, *Water resources development, *Water distribution (Applied), Legal aspects, Legislation, Water utilization, Administration, Local governments, Political aspects, Water rates, Public utilities, Water works, Taxes, Assessments, Costs, Tax rate, Financing, Investment, Loans, Principal, Eminent domain, Condemnation, Cities, Water management (Applied), Interest.

Metropolitan water supply districts may be created within counties to secure a source of water on a larger scale than is feasible for public water supply districts and municipalities acting alone. Such metropolitan districts may sell water at wholesale to other systems and municipalities within the district. Territorial and political restrictions are placed upon the formation and control of the districts, including the necessity of obtaining consent from a municipality having a water supply system. Procedural requirements for district incorporation and membership, organization, compensation, election, and removal of a district's board of directors are enumerated. A board may: enter contracts and agreements to develop, construct, acquire or operate water supply facilities; issue and refund bonds; exercise the power of eminent domain; fix rates and collect for the sale of water; levy and collect ad valorem taxes; and exercise all rights and powers necessary to carry out the purpose of the district. Procedures are established for the levying of taxes, the changing of boundaries, the inclusion or exclusion of property, and the dissolution of a district. (Casey-Florida)
W70-06087

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, SUMMARY REPORT.
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06185

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME I - TEXT.
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06186

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME II - TECHNICAL APPENDICES.
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06187

PLANNING PROGRAM (1969).
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06B.
W70-06188

RECLAMATION AND REUSE - THE STATE OF THE ART,
Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 08D.
W70-06260

NOTES ON VIRGINIA WATER LAWS AND AGENCIES.
Virginia Dept. of Conservation and Economic Development, Richmond, Va. Div. of Water Resources.
For primary bibliographic entry see Field 06E.
W70-06297

3E. Conservation in Industry

POLLUTION CONTROL AND THE FEDERAL POWER COMMISSION,
For primary bibliographic entry see Field 05G.
W70-06292

3F. Conservation in Agriculture

SOIL NITRATE, SOIL WATER, AND GRAIN YIELDS IN A WHEAT-FALLOW ROTATION IN THE GREAT PLAINS AS INFLUENCED BY STRAW MULCH,
Agricultural Research Service, Mandan, N. Dak. Northern Plains Branch.
For primary bibliographic entry see Field 02I.
W70-06002

HOW TO INSTALL FLEXIBLE MEMBRANE CANAL LININGS,
Tyler H. Quackenbush.
Agricultural Engineering, Vol 48, No 9, p 500-501, September 1967.

Descriptors: *Irrigation canals, *Installation, *Membranes, *Canal linings, *Linings, Plastics, Canal construction, Canal design, Irrigation, Irrigation ditches, Water conveyance, Seepage, Foundations, Synthetic rubber.
Identifiers: Seepage control, Butyl, Vinyl.

In areas in which seepage control is a problem or foundation conditions preclude more rigid types of linings, it is often preferable to use irrigation canal linings made of flexible membranes. Optimal membrane thickness depends primarily on subgrade conditions, with course soils requiring 8 mil vinyl or polyethylene and 15 mil butyl. 15 mil vinyl or polyethylene and 30 mil butyl would be necessary on gravel surfaces. When the subgrade is prepared prior to membrane installation, care must be taken to remove any objects which might puncture the lining. Backfilled anchor trenches on either side of the membrane are used to hold the lining in place. For longest membrane life, it is best to cover its entire surface with at least six inches of earth. This prevents deterioration by sunlight and damage by livestock. A side slope of about 3:1 is flat enough to retain the cover material. (Carr-Arizona)
W70-06007

SUBSURFACE IRRIGATION, HOW SOON A REALITY,
California Univ., Riverside.
Sterling Davis.
Agricultural Engineering, Vol 48, No 11, p 654-655, November 1967. 5 fig.

Descriptors: *Subsurface irrigation, *Irrigation engineering, *Irrigation, *Pipes, *Application equipment, Distribution systems, Irrigation systems, Irrigation design, Plastics, Plastic pipes, Conduits, Conveyance structures, Equipment, Application methods, Hoses, Installation, Durability, Costs, Root zone.
Identifiers: Flow continuity, Root penetration.

The major reason for interest in subsurface irrigation is the possibility it holds for even, automatic water application combined with reduced evaporation losses. One of the crucial components of a subsurface irrigation system is the applicator which transfers water from the pipe to the soil. A successful applicator must have the qualities of durability, flow continuity, economy, easy installation, easy replacement, and resistance to root penetration. These qualities were evaluated for several underground water applicators. Applicators are described and their test performances discussed. (Carr-Arizona)
W70-06008

RELATIONSHIP OF WATER QUALITY AND SOIL PROPERTIES TO SEEPAGE PROBLEMS,
Seepage Control Inc., Phoenix, Ariz.
For primary bibliographic entry see Field 03C.
W70-06009

ECONOMIC COMPARISONS OF OPEN CONDUIT AND PIPE IRRIGATION DISTRIBUTIONS SYSTEMS,
Bureau of Reclamation. Div. of Irrigation Operations.
B. A. Prichard.
Proceedings, Seepage Symposium, Second, March 25-27 1968, Phoenix, Arizona, U.S. Department of Agriculture, Agricultural Research Service ARS 41-147:134-138. April 1969. 2 tab, 4 ref.

Descriptors: *Economic justification, *Conduits, *Distribution systems, *Benefits, *Costs, Canal linings, Canals, Canal seepage, Cost-benefit ratio, Intangible benefits, Tangible benefits, Economic feasibility, Economic efficiency, Economics, Decision making, Water conservation, Water supply, Irrigation canals, Irrigation operation and maintenance, Concrete-lined canals, Laterals, Canal design, Engineering structures, Water conveyance, Conveyance structures.
Identifiers: *Seepage control, *Bureau of Reclamation.

Discussed in this contribution is a Bureau of Reclamation study which concerns economic justifications for lining irrigation canals with concrete or using pipe systems. The Bureau reached the following conclusions: (1) The most significant factor in determining economic justification for canal lining is the value of water which the lining conserves. (2) Canal linings are generally economically justified in areas where irrigable land exceeds available water supply. (3) Other tangible benefits of canal lining include reduced right-of-way costs, reduced investment costs for storage and drainage systems, and reduced OM and R costs. (4) Among the intangible benefits are such items as improved safety and farm appearance and reduction in water contamination by herbicides. Study of a sample area showed that lined canals with open-lined laterals had the highest benefit-cost ratio and the greatest excess of benefits over costs. (See W70-06026). (Carr-Arizona)
W70-06025

NO-TILLAGE CORN - CHARACTERISTICS OF THE SYSTEM,
Agricultural Research Service, Washington, D.C.
Lloyd L. Harrold, Glover B. Triplett, and William M. Edwards.
Agricultural Engineering Vol 51, No 3, p 128-131, Mar 1970.

Descriptors: *Cultivation, *Weed control, *Herbicides, *Mulch, *Erosion control, *Soil moisture conservation, Crop production, Plant nutrients.
Identifiers: *No tillage, *Planting, Coshocton, Ohio.

No-tillage corn consists of killing existing vegetation with a herbicide that also prevents growth of weeds from seeds in the soil, planting corn seed with practically no soil disturbance, and harvesting the crop. Corn may be planted in either a killed sod or following a row crop. Herbicides are selected to kill specific types of vegetation. In areas where existing vegetation is difficult to kill, no-tillage culture is not recommended. Sod sprayed 2 weeks before corn planting provided much more mulch throughout the growing season than that sprayed 2 weeks earlier. Mulch protected the soil from erosion and conserved greater amounts of soil water by reducing evaporation, compared to conventional clean plowed corn fields. On well-drained soil near Coshocton, Ohio, corn yield by no-tillage practice averaged 116 bu/acre -- 8 bu/acre more than that for conventional practice. Soil erosion was 24 and 1550 lbs/acre, respectively. Problems needing additional research are: optimum seedbed and land surface environment, unfavorable water and temperature conditions in poorly-drained soil, and pests. (Harrold-USDA, ARS)

W70-06039

INCORPORATION OF AGRICULTURAL RISK INTO WATER RESOURCES PLANNING MODELS,
Texas A and M Univ., College Station. Inst. of Statistics; and Texas A and M Univ., College Station. Water Resources Inst.
James Richard Conner.
Technical Report No. 25, Jan 1970. 108 p, 10 tab, 17 fig, 27 ref, 2 append. OWRR Project C-1227.

Descriptors: *Reservoir design, *Simulation analysis, *Optimization, *Hydrologic data, Risks, Irrigation, Benefits, Agriculture, Water resources.
Identifiers: Twin Buttes Reservoir Project, Marginal value product.

The combination of design variables that maximized the economic efficiency of the Twin Buttes Reservoir Project was determined using simulation analysis. Two approaches to the problem were used: (1) maximization of net benefits, (i.e. the traditional benefit-cost ratio approach), and (b) maximization of marginal value product net returns, treating the system as a business enterprise. Decision variables were: reservoir capacity, the number of acres to be irrigated, and the amount of water to be furnished to each irrigation acre, including rainfall. Three hydrologic risk elements were considered. They were: (a) reservoir inflows, (b) reservoir evaporation rates and (c) rainfall. The risk variables influenced the net benefits that were obtained from various combinations of levels of the decision variables. A comparison of the two approaches concluded that the primary net benefits produces more reliable information than the marginal value product approach. (Kriss-Cornell)
W70-06100

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FLOOD HAZARD INFORMATION, POTOMAC RIVER AND TRIBUTARY STREAMS, STAFFORD COUNTY, VIRGINIA.
Corps of Engineers, Baltimore, Md.

Corps Engineers Flood Hazard Information Report, November 1969. 4 p, 1 plate.

Descriptors: *Floods, *Virginia, *Flood forecasting, *Tides, Maximum probable flood, Design flood, Tidal effects, Hurricanes.
Identifiers: Potomac River, Intermediate regional flood, Standard project flood, Intermediate regional tide, Standard project tide.

Flood hazard information for the Potomac River and tributary streams in Stafford County, Virginia, was prepared to aid in the solution of local flood problems and in planning the best use of lands subject to overflow. The information is based upon available data on historic and current tidal heights, and technical studies bearing upon the occurrence and heights of tides in the Stafford County area. The data presented indicate the extent of past flooding and that which might result from probable future high tides; namely, Intermediate Regional Tides and Standard Project Tides. Intermediate regional tides have an average frequency of occurrence in the order of once in 100 years, and are determined from an analysis of known tides in the general area of study. Standard project tides are tides of rare occurrence, and generally are considerably higher than any tides that have occurred in the past. However, they should be considered in planning the use of flood plains. From the data presented, the depth of probable flooding, either by recurrence of the highest known tide or by occurrence of the Intermediate regional or Standard project tides, may be determined. (Knapp-USGS)
W70-05918

FLOOD PLAIN INFORMATION, LATTAS AND SAN DIEGO CREEKS, ALICE, TEXAS.
Corps of Engineers, Galveston, Tex.

Corps Engineers Flood Plain Report, June 1969. 43 p, 8 fig, 12 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Alice (Tex), Standard project flood, Intermediate regional flood.

Flooding of Alice, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05919

FLOOD PLAIN INFORMATION OF JACKSON RIVER, COVINGTON, CLIFTON FORGE AND ALLEGHANY COUNTY, VIRGINIA.
Corps of Engineers, Norfolk, Va.

Corps Engineers Flood Plain Report, July 1969. 39 p, 10 fig, 7 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Jackson River (Va), Standard project flood, Intermediate regional flood.

Flooding of the Jackson River, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05923

PROVISIONS AS TO DITCHES, DRAINAGE AND RECLAMATION (FINANCING DRAINAGE PROJECTS).

Ky Rev Stat Ann secs 269.010 - 269.140 (1963).

Descriptors: *Financing, *Kentucky, *Drainage, *Drainage districts, Government finance, Legislation, Ditches, Administrative agencies, Drainage systems, Taxes, Assessments, Payment, Local governments, Federal government, Legal aspects, Drainage programs, Drainage effects, Costs, Cost allocation, Tax rate, Political aspects, Land reclamation, Surface drainage, Land use, Land tenure.

Methods of funding drainage projects, largely through refunding bonds and taxes, and the organization and powers of drainage districts are set forth. The issue of refunding bonds is authorized to fund the activities of drainage districts. Drainage districts may accept federal benefits. The county is given the power to drain lands, and may utilize condemnation if necessary. If the cost of improvements is more than the annual revenue of the county concerned, an election must be held to provide funding. Counties may be split into taxing districts to pay for improvements. Provisions are made for the appointment of commissioners who may sell bonds and enter contracts. (Caldwell-Florida)
W70-06001

RELATIONSHIP OF WATER QUALITY AND SOIL PROPERTIES TO SEEPAGE PROBLEMS,
Seepage Control Inc., Phoenix, Ariz.
For primary bibliographic entry see Field 03C.
W70-06009

PROVISIONS AS TO DITCHES, DRAINAGE AND RECLAMATION (ASSESSMENTS FOR DRAINAGE PURPOSES).

Ky Rev Stat Ann secs 269.150 - 269.200 (1963).

Descriptors: *Kentucky, *Taxes, *Drainage districts, *Government finance, Legislation, Judicial decisions, Drainage, Ditches, Administrative agencies, Drainage systems, Assessments, Payment, Local governments, Legal aspects, Drainage programs, Drainage effects, Costs, Cost allocation, Tax rate, Land reclamation, Surface drainage, Evaluation, Land use, Adjudication procedure.

Upon making a tac assessment for drainage purposes, the boards of commissioners of drainage districts must publish proper notice of the means of challenging such assessments. The Circuit Courts will pass on such challenges, and enter a final ruling on whether the assessments were properly made. Dates of assessment and due dates are specified, a discount being provided for prompt payment. Drainage districts shall have a general lien for all taxes upon the lands assessed and upon all personal property of the owners not otherwise exempt from execution. A ten year statute of limitations is provided for the enforcement of the lien. Districts may enforce their liens by moving for a 'show cause' order to be issued by the Circuit Court, or by suit in court. Such suit may be in law or equity, equitable actions being conducted like suits upon liens arising out of contracts. (Caldwell-Florida)
W70-06010

SEEPAGE AND SEEPAGE CONTROL PROBLEMS IN SANITARY LANDFILLS,
Los Angeles County Sanitation District, Los Angeles, Calif.
Frank R. Dair.
Proceedings, Seepage Symposium, Second, March 25-27, 1968, Phoenix, Arizona, U.S. Dept. of Agriculture, Agricultural Research Service ARS 41-147, April 1969, p 14-16.

Descriptors: *Water pollution, *Groundwater, *Seepage, *Landfills, *Solid wastes, Water pollution sources, Water pollution control, Public health, Environmental sanitation, Waste disposal, Disposal, Wastes, California, Percolating water, Percolation, Leaching, Aquifers, Water table, Water supply, Gases, Carbon dioxide, Methane, Barriers, Infiltration.
Identifiers: *Seepage control.

Groundwater pollution resulting from solid waste landfills has been the subject of intensive investigation in southern California. Although these studies have produced an enormous quantity of data, the major problems of groundwater pollution from landfills go unsolved. Research is needed to discover feasible yet sanitary methods of depositing refuse in direct contact with groundwater. Further study is also required to determine whether water does in fact leach through landfills in appreciable amounts and percolate down to the water table. Experimentation should also proceed in an attempt to develop barriers to prevent the escape of refuse-produced gases into the groundwater. (See W70-06012). (Carr-Arizona)
W70-06011

BATON ROUGE CONTRACTING CO V WEST HATCHIE DRAINAGE DISTRICT OF TIPPAH COUNTY (ADDITIONAL COMPENSATION SOUGHT FOR WORK NECESSITATED BY CAVE-INS).

304 F Supp 580-592 (N D Miss 1969).

Descriptors: *Mississippi, *Channel improvement, *Construction costs, *Bank stability, Drainage districts, Contracts, Slope stability, Soil conservation, Drainage, Intakes, Excavation, Construction, Channels, Canal construction, Land clearing, Specifications, Performance, Judicial decisions, Legal aspects.
Identifiers: *Cave-ins.

Plaintiff construction company sued defendant drainage district to recover for extra work incurred in performance of a contract for channel improvement. Defendant, in its invitations for bids on the channel improvement project, furnished specifications and drawings which indicated soil type and water level. As work progressed, plaintiff experienced sliding and caving-in of the channel bank which necessitated extra work in removing the dirt deposited by the cave-ins. Furthermore, the channel design called for construction of spur inlets as located on the drawings. Defendant moved these inlets to different locations and added more of them. Plaintiff sough compensation for the extra work caused by the cave-ins and the spur inlet relocations. The court found that defendant's design was not defective. There was no latent condition not anticipated in the contract. Plaintiff was experienced in this field. He should have known from the drawings and specifications that cave-ins might be encountered in performance of the work. Recovery was denied. However, the increased costs of construction caused by defendant's changes were awarded to plaintiff. (Cuevas-Florida)
W70-06013

SECOND CLASS CITIES (CONSTRUCTION OF SEWERS).

Mo Ann Stat secs 88.443 thru 88.457 (1952).

Descriptors: *Missouri, *Cities, *Drainage systems, *Sewers, Drains, Public health, Condemnation, Legislation, Legal aspects, Municipal wastes, Urbanization, Sanitary engineering, Environmental sanitation, Drainage programs, Assessments, Water management (Applied), Sewage disposal, Engineering structures, Drainage engineering, Utilities, Cost allocation, Construction, Taxes.

The city council shall have the power to establish a general sewer system, composed of public, district, joint district and private sewers. Public sewers may be established along the principal courses of drainage. District sewers may be established within the limits of the district and connected with public sewers, other district sewers, or the natural course of drainage. The council shall construct sewers in each district whenever necessary for sanitary or other purposes. Joint district sewers are constructed by second class cities whenever it is necessary for a sewer to be constructed in any part of the city containing two or more sewer district. The apportionment of the cost of constructing a joint district sewer is regulated. The council by ordinance regulates the construction of private sewers. No sewer shall run diagonally through private property when it is practicable to construct it parallel with one of the exterior lines of such property. No public sewer shall be constructed through private property whenever it is as practicable to construct it along or through a street or other public highway. The council has the power to condemn private property for public use, occupation of possession in the construction and repair of the general sewer system. Special tax bills for improvements are regulated. (Powell-Florida)
W70-06014

MUNICIPAL CORPORATIONS - GENERAL POWERS (CONTROL OF WATER SUPPLY AND WATERCOURSES).
For primary bibliographic entry see Field 03D.
W70-06015

PROTECTION FROM FLOODS.
Iowa Code Ann secs 395.1-395.5, 395.15-395.17 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Flood control, *Flood protection, *Local governments, Levees, Legislation, Boundaries (Property), Assessments, Taxes, Ditches, Jurisdiction, Watercourses (Legal), Condemnation, Right-of-way, Conduits, Channels, Bridge construction, Railroads, Legal aspects, Bridges, Cities, Costs, Cost repayment.

Cities and towns may alter and improve watercourses within their limits and widen or establish streets across and adjacent to such watercourses. Special taxes and assessments may be levied for this purpose. Property may be condemned within and outside city limits to give effect to these provisions. One hundred or more city taxpayers may petition the city council to undertake improvements on specific areas of land, and the city council may approve and begin the improvements. Improvements may cross the right-of-way of a railroad, and it will be the duty of the railroad to construct necessary bridges or be liable for the costs incurred by the city in building them. (Hubener-Florida)
W70-06016

IN-SITU-FABRICATED MEMBRANES,
Witco Chemical Corp., New York. Pioneer Div.; and Witco Chemical Corp., New York. Research and Development Lab.
Herbert Goldstein, and Samuel I. Horowitz.
Proceedings, Seepage Symposium, Second, March 25-27, 1968, Phoenix, Arizona, U.S. Department of Agriculture, Agricultural Research Service, ARS 41-147, April 1969, p 57-60.

Descriptors: *Membranes, *Asphalt, *Fabrication, *Spraying, Canal linings, Linings, Seepage, Sealants, Permeability, Mixing, Equipment, Application equipment, Application methods, Rates of application, Rubber, Films, Elastomers, Viscosity.

A new system has been developed by which membranes can be fabricated in situ. Two low viscosity liquids are sprayed through two-component metering equipment directly onto the substrate to be covered. The substrate need not be perfectly level, and as long as no free water is present, can be wet or dry. When a spray tip of 25 mils or larger is used, an application rate of 6.5- to 7-gal/100 sq ft is recommended. The major advantages of this system over plastic films and sheeting are that no hand-sealing of materials is required and labor cost is much lower. Composition of the liquids cannot be revealed because patents are pending. (See W70-06018). (Carr-Arizona)
W70-06017

PINE SEEDLINGS RESPOND TO LIMING OF ACID STRIP-MINE SPOIL,
Forest Service (USDA), Princeton, W. Va. Northeastern Forest Experiment Station.
William T. Plass.
U. S. Forest Serv. Res. Note NE-103, 8 p. 1969.

Descriptors: *Pine trees, *Lime, *Soil stabilization, *Strip mines, Reclamation, Spoil banks, Soil chemical properties, Fertilization, Appalachia, Kentucky.
Identifiers: *Acidic spoils, *Strip mine reclamation.

A greenhouse trial was made to determine the effect of three rates of liming on the growth of five species of pine seedlings in an extremely acid strip-mine spoil. Liming at the rate of 5 tons per acre-foot significantly increased the growth of four of the species. Tissue analysis indicated the growth rate may be related to a reduction in the concentration of the metallic ions of manganese, iron, copper, and zinc. (Plass-USFS)
W70-06037

WATER RESOURCES (MASTER WATER MANAGEMENT DISTRICTS).

Miss Code Ann secs 5956-101, 5956-103 thru 5956-106, 5956-108 thru 5956-110, 5956-114 (Supp 1968).

Descriptors: *Mississippi, *Water conservation, *Administration, *Water resources development, Legislation, Legal aspects, Drainage, Water utilization, Impoundments, Diversion, Recreation, Beneficial use, Drainage districts, Planning, Boundaries (Property), Water resources, Construction, Financing, Assessments, Regulation, Eminent domain, Surveys, Federal government, Water districts.
Identifiers: *Water management districts, Land acquisition, Bonds.

The purpose of this act is to provide for the creation of master water management districts. Districts will carry out works of improvement for the purposes of: (1) drainage; (2) flood damage prevention; or (3) conservation, development, utilization and disposal of water including the impoundment, diversion, flowage and distribution of waters for recreation, welfare and other beneficial uses. District authority is limited to plans for improvements developed and carried out in cooperation with federal agencies. District organization is initiated by petition to the chancery court. Districts will be created in accordance with provisions of this act. Boards of commissioners will be the governing bodies of the districts. The boards will have the power to: (1) contract; (2) adopt regulations necessary for carrying out the purposes of this act; (3) acquire land; (4) conduct surveys; (5) construct, maintain and operate works of improvement; and (6) do any and all things not inconsistent with the laws of this state in carrying out the purposes of this act. The boards are authorized to borrow money, issue bonds and tax district lands in proportion to the benefits accruing to them in order to finance district projects. (Keith-Florida)
W70-06042

INCORPORATION OF AGRICULTURAL RISK INTO WATER RESOURCES PLANNING MODELS,
Texas A and M Univ., College Station. Inst. of Statistics; and Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 03F.
W70-06100

FLOODS FROM SMALL DRAINAGE AREAS IN CALIFORNIA,
Geological Survey, Menlo Park, Calif. Water Resources Div.
Arvi O. Waananen.
Geological Survey Data Compilation Report, July 1969. 201 p, 95 fig, 3 tab.

Descriptors: *Floods, *Small watersheds, *California, Data collections, Hydrologic data, Stream gages, Gaging stations, Stage-discharge relations, Surface waters, Discharge measurement, Hydrographs, Rain gages.
Identifiers: Flood data (Calif)

An investigation of the magnitude and frequency of floods from California drainage areas generally of less than about 10 square miles was begun by the Geological Survey July 1, 1958. The objective of the program is to obtain sufficient basic hydrologic data to define for such areas the magnitude and frequency of floods on a regional basis for the entire State, and to obtain sufficient flood-hydrograph data, on a statewide basis, for detailed hydrologic study. The report consists of a tabulation of the annual peak stage and discharge, by water years, for each gaging station in the program. The discharge hydrograph and recorded graph of accumulated rainfall for significant peak discharges during the current year are included for stations that are equipped with water-stage recorders. Monthly and annual rainfall totals are given for th

recording stations. In addition, discharge hydrographs and precipitation graphs, as well as monthly and annual precipitation, published in previous annual reports, are repeated in this report to provide a complete record. Program activities during the current year and program plans for the following year are summarized briefly. (Knapp-USGS)
W70-06142

FLOOD PLAIN INFORMATION, CROOKED CREEK AND TRIBUTARIES, CENTRALIA, ILLINOIS.
Corps of Engineers, St. Louis, Mo.

Corps Engineers Flood Plain Report, July 1969. 60 p, 20 fig, 13 plate, 15 tab.

Descriptors: *Floods, *Flood damage, Illinois, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Centralia (Ill), Standard project flood, Intermediate regional flood.

Flooding of Centralia, Illinois is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06156

DRAINAGE (PROCEDURE FOR LANDOWNER TO IMPROVE DRAINAGE OF HIS LAND).

Conn Gen Stat Ann secs 52-456 thru 52-461 (1960).

Descriptors: *Connecticut, *Drains, *Drainage effects, *Drainage practices, Judicial decisions, Legal aspects, Legislation, Easements, Channeling, Controlled drainage, Obstruction to flow, Ditches, Flow, Water policy, Damages, Assessments, Administration, Drainage water, Riddance (Legal aspects), Canals, Culverts, Adjudication procedure, Costs, Cost allocation.

When a landowner wishes to drain his lands, he may do so by deepening or widening a natural stream. If he is unable to agree with adjacent landowners as to the mode of drainage and the amount of damages, he may make complaint to the superior court of the county for power to drain across the lands of adjoining proprietors. Upon the filing of such complaint, the court will appoint three disinterested landowners to assess the damages and determine a drainage method. Their report in writing may be attacked by any interested party for irregularity or improper conduct. Three other persons may reassess the damages upon appointment of the court. Such reassessment may also be set aside on a showing of improper conduct. Costs of these proceedings shall be awarded at the discretion of the judge except in reassessment cases, where the party filing for reassessment bears the costs when he does not receive a higher damage valuation as a result thereof. When a ditch or channel across low lands is used for drainage by an adjoining proprietor, any obstruction to such ditch must be removed at the expense of the dominant tenant. (Barnett-Florida)
W70-06180

PRELIMINARY MASTER PLAN FOR BOULDER CREEK FROM 24TH TO 30TH STREETS.
Wright-McLaughlin Engineers, Denver, Colo.

City of Boulder, Colorado, November 1969. 30 p, 4 fig, 3 tab.

Descriptors: *Flood control, *Runoff, *Drainage engineering, *Storm runoff, *Stream improvement, *Stream stabilization, *Channel improvement, *Snowmelt, Mountains, Stream erosion, Streamflow.
Identifiers: *Boulder (Colo), *Boulder Creek.

An environmental design team was organized to study flooding problems along Boulder Creek in Boulder, Colorado between 24th to 30th Streets. Severe flooding caused by a combination of precipitation and mountain snowmelts, usuallyoccurring in May and June, prompted the engineering planning study. Flood control planning and engineering for this stretch of Boulder Creek is complicated by the presence of five vehicular bridges. The concensus of the team favored the (unconventional) concept of a heavily armored channel designed to carry the mean annual flood with an overflow area capable of transporting a 100-year flood through the project with one foot of freeboard. This would create a floodway approximately 150 feet wide. It is significant that the design team favored this novel approach over the historically popular approach of constructing the most hydraulically efficient higher-velocity channel. The report includes recommendations to Boulder citizens to arrange for flood insurance when the area is approved for insurance and the rates are set. The City and County of Boulder are counseled to delay further land development along the Boulder Creek channel and to be careful about upstream mountain subdivision road-cutting and land-clearing. The estimated construction costs to implement the proposed plan is $550,000. (Poertner-Chicago)
W70-06189

MASTER PLANNING FOR STORM RUNOFF FOR NEW NORTH/SOUTH RUNWAY AND ENVIRONS--STAPLETON INTERNATIONAL AIRPORT.
Wright-McLaughlin Engineers, Denver, Colo.

City and County of Denver, Department of Public Works, November 1969. 39 p, 13 fig, 5 tab.

Descriptors: *Storm runoff, *Ponding, *Airports, *Detention reservoirs, *Drainage, *Drainage engineering, *Drainage programs, *Runoff, Pondage, Flood control.
Identifiers: *Denver, *Stapleton International Airport, *Master plan for storm runoff, Airport planning.

This engineering report is unique because it incorporates new and unconventional concepts in planning drainage facilities for removal of stormwater runoff. The master plan for providing stormwater drainage at Stapleton Airport emphasizes detention and slow discharge of runoff at outlet points. Conventional designs usually embody high discharge rates at outlets which promotes downstream flooding. The drainage of Stapleton Airport has been complicated by the construction of a new highway and a new runway, both of which combined to block overland drainage and discharge to Sand Creek. In addition, new land development nearby and the probability of constructing another runway further complicates the drainage problem. The engineers propose the development of unconcentrated overland flow planes as well as swales and grass-lined open channels on flat grades to convey runoff slowly to existing and proposed detention ponds and outlets. Rooftop ponding is recommended for new buildings proposed on and near the airport. Undersized storm sewers are recommended to force overland flow during intense storms--thereby reducing discharge rates and downstream flooding. (Poertner-Chicago)
W70-06190

LEVEE AND DRAINAGE DISTRICTS (LOCATION OF DISTRICT IMPROVEMENT NEAR PUBLIC HIGHWAY).

Iowa Code Ann secs 455.116-455.128 (1945), as amended, (Supp 1969).

Descriptors: *Iowa, *Drainage districts, *Levees, *Construction, Railroads, Legislation, Legal aspects, Bridges, Ditches, Drains, Highways, Watercourses (Legal), Right-of-way, Public utilities, Embankments, Engineering structures, Water control, Water management (Applied), Drainage systems, Drainage programs.

Within a levee or drainage district a levee, ditch, drain or improvement can be located and constructed within the limits of any public highway so long as public travel is not materially interfered with. Public highways may be established along and upon any levee or embankment. Any secondary road bridge may be moved, built or rebuilt where a levee, ditch, drain, or change of any natural watercourse crosses a public highway. Whenever a proposed levee, ditch, drain, or watercourse improvement crosses a railroad right-of-way, the county auditor shall notify the railroad company. Such company has a duty to construct the improvement according to the county engineer's plans and specificaitons. Such railroad company shall assume the cost of building, rebuilding, constructing, reconstructing, changing or repairing any culvert or bridge when such improvement is located at the natural waterway or place provided by the railroad company. Steam or electric railway companies shall furnish the drainage contractor with unrestricted passage for his equipment across their rights-of-way and telegraph, telephone and signal lines. Other public utilities shall also furnish such passage. Annexation of additional lands for a levee or drainage district is regulated. (Powell-Florida)
W70-06237

DAMS, MILLS (REGULATION OF CONSTRUCTION AND ALTERATION OF DAMS).
Mo Ann Stat secs 236.190 thru 236.280 (1952), sec 236.255 (Supp 1970).

Descriptors: *Missouri, *Dams, *Mills, *Water pollution control, Dimensions, Electric power industry, Regulation, Obstruction to flow, Streams Natural flow, Domestic water, Chutes, Aprons, Hydraulic structures, Currents, Fish passages, Navigation, Repairing, Abutments, Riparian rights, Water pollution, Pollution abatement, Maintenance, Legislation, Legal aspects.

Any owner of a dam, mill, electric power and light works, or other machinery may increase the altitude of his dam by permission of court. The inquest of the jury or the order of the court shall not bar actions for injuries caused by such construction, except such as were actually foreseen and estimated by the jury. The circuit court, upon petition, may prevent the erection or raising of any dam, stoppage or obstruction which shall: operate as a nuisance, be injurious to other works constructed on the stream, or which shall pollute stream waters used for domestic supply. Dams shall have minimum chute or apron sizes providing for adequate flow of water and free passage of fish. Violations of this provision, resulting in a swelling of streams, shall be a misdemeanor. All dams, stoppages and obstructions not made according to law shall be deemed public nuisances. Persons having obtained permission to erect a dam but who fail to comply with the requirements of law shall forfeit the legal rights attendant with such permission. In the interest of navigation, the state may require the removal of dams or prohibit construction. Provisions outline penalties for building without permission and describe the procedures for diversion of streams. (Duss-Florida)
W70-06243

HOBAUGH V CUNNINGHAM (SURFACE WATER DRAINAGE ACROSS HIGHWAY).
Fayette Legal Journal, Vol. 10, p 57-60 (Fayette County Ct, Pa 1947).

Descriptors: *Pennsylvania, *Riddance (Legal aspects), *Surface drainage, *Surface runoff, Surface waters, Rain water, Natural flow, Waste water (Pollution), Ditches, Highways, Underground, Judicial decisions, Land use, Relative rights, Repulsion (Legal aspects), Legal aspects, Culverts, Waste water disposal, Land tenure.

Plaintiff, owner of rural land on the lower side of a hillside highway, sought to restrain defendants, owners of higher land on opposite side of the highway, from collecting surface water and discharging it, along with waste matter, through an underground drain to a ditch on the highway. From the ditch the discharge flowed through a culvert onto the plaintiff's land. The county court held for defendants, stating that no waste matter had been discharged into the ditch and that the mere accumulation of water on the roof and in the basement of a house on the higher land could be legally returned to the natural course into which it would otherwise flow. So long as he does not divert it from its natural channel or cause any unnecessary injury, the upper landowner may collect the surface water and increase its flow by either surface or underground drainage. (Hubener-Florida)
W70-06293

NAVIGABILITY IN THE MISSOURI RIVER BASIN,
For primary bibliographic entry see Field 06E.
W70-06294

LEVEE AND DRAINAGE DISTRICTS.
Iowa Code Ann secs 455.132 - 455.135 (1945), as amended (Supp 1969).

Descriptors: *Iowa, *Drainage districts, *Levees, *Drainage, Drainage systems, Legislation, Legal aspects, Watercourses (Legal), Assessments, Repairing, Construction, Maintenance, Eminent domain, Easements, Right of way, Erosion, Erosion control, Meanders, Streams, Natural streams, Administrative agencies.

When the establishment, change or repair of a drainage district or the change of a natural watercourse is unsuccessful for any reason either before or after the improvement is completed, the Board of Supervisors can re-establish such district or improvement. If any levee or drainage district or improvement is insufficient to properly drain all of the lands tributary thereto, the Board can establish a new district encompassing the old district or improvement in addition to the extra lands deemed necessary. Parties owning the old improvement which is so encompassed shall receive credit for the value of the old improvement when benefits and costs of the new improvement are assessed and apportioned. The Board has a duty to keep in repair any levee or drainage district or improvement. The governing body of the district may, by contract, conveyance or eminent domain, acquire the necessary lands or easements for making repairs or improvements. Districts established for the straightening, widening, deepening, or changing of a natural watercourse acquire an easement for the right of way of sufficient width to accommodate reasonably anticipated erosion and meander of such stream. In existing districts where a stream has by erosion appropriated lands beyond its original right of way, an easement for such erosion and meander may be acquired if it is more economical and feasible than the containment of the stream, in its existing right of way. (Powell-Florida)
W70-06295

RECENT DEVELOPMENTS AFFECTING PUBLIC LANDS OF THE STATES--1968,
For primary bibliographic entry see Field 06E.
W70-06296

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT,'
For primary bibliographic entry see Field 06E.
W70-06307

4B. Groundwater Management

HYDROGEOLOGIC INFORMATION ON THE GLORIETA SANDSTONE AND THE OGALLALA FORMATION IN THE OKLAHOMA PANHANDLE AND ADJOINING AREAS AS RELATED TO UNDERGROUND WASTE DISPOSAL,
Geological Survey, Washington, D.C.
James H. Irwin, and Robert B. Morton.
Report available free on application to U S Geological Survey, Washington, D C 20242. Geological Survey Circular 630, 1969. 26 p, 4 fig, 4 plate, 2 tab, 43 ref.

Descriptors: *Hydrogeology, *Water pollution sources, *Waste water disposal, *Injection wells, *Leakage, Texas, Oklahoma, Underground, Groundwater movement, Seepage, Aquifers, Brines, Saline water, Saline water intrusion.
Identifiers: Glorieta Sandstone, Ogallala Formation.

The Oklahoma Panhandle and adjacent areas in Texas, Kansas, Colorado, and New Mexico have supplies of fresh water and of oil and gas. The Ogallala and, in places, Cretaceous rocks produce fresh water through approximately 9,000 irrigation and public-supply wells and a large number of other wells. Disposal of oil-field brine and other wastes into the Glorieta Sandstone is of concern because of the possibility of pollution of the overlying fresh-water aquifers, particularly the Ogallala Formation. Permits for 147 disposal wells into the Glorieta have been issued in this area. In the report area, the Glorieta Sandstone lies at depths ranging from about 500 to 1,600 feet below the base of the Ogallala Formation. The rocks between those two formations are relatively impermeable but solution has resulted in collapse in some places, resulting in increased vertical permeability. This might result in movement of brine under hydrostatic head from the Glorieta Sandstone into overlying fresh-water aquifers. (Knapp-USGS)
W70-05922

A BRIEF STUDY TO EVALUATE THE OPTIMAL GROUNDWATER WITHDRAWAL IN A RELATIVELY LARGE RIVER BASIN IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, Delft (Netherlands).
W. Visscher.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 181-191, 1968. 11 p, 5 fig, 1 tab.

Descriptors: *Withdrawal, *Groundwater rechatge, *Watersheds (Basins), *Water balance, Rivers, Water table, Storage capacity, Runoff, Aquifers, Water yield, Precipitation (Atmospheric), Discharge (Water), Drainage systems, Safe yield.
Identifiers: *Netherlands, Dommel River, Noord-Brabant Province.

A study of water balance was undertaken to determine the optimum groundwater withdrawal in the Netherlands, specifically in the Dommel River basin. This sandy area has a shallow water table and consequently a low storage capacity. The underground runoff to the Meuse River Valley is surprisingly low; groundwater discharges mainly into the local drainage ditches and canals. Any increase of groundwater withdrawal will also decrease the discharge of groundwater into the local drainage systems. An indication of the magnitude of the net precipitation, discharge and the recharge of an aquifer can be obtained by using simple methods. A simple relationship between the groundwater withdrawal and the lowering of the water table is given for determining the maximum safe yield. (Carstea-USGS)
W70-05934

THE GROUNDWATER BALANCE VARIATION IN THE EXPLORATION AND DEVELOPMENT OF ARTESIAN BASINS,
For primary bibliographic entry see Field 02F.
W70-05935

ARTIFICIAL RECHARGE THROUGH INJECTION WELLS IN A SANDSTONE AQUIFER,
Nebraska Univ., Lincoln.
R. R. Marlette.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 300-308, 1968. 9 p, 5 fig, 2 tab, 4 ref.

Descriptors: *Artificial recharge, *Injection wells, *Aquifers, *Sandstones, Groundwater recharge, Pump testing, Withdrawal, Water levels, Piezometers, Saline water intrusion, Tracers, Nebraska.
Identifiers: *Sandstone aquifers.

Pump tests were made in an aquifer which is located within the City of Lincoln, Nebraska. Water level changes caused by withdrawal and recharge of single wells and of an entire wellfield were computed by using formulas for groundwater flow to wells. Computed and measured water levels of pumped wells were compared. Well designs for the recharge system, operating procedures, and the use of tracers and piezometric levels to define the recharge dynamics are described. Prevention of saline water intrusion into the wellfield by using injected water is also discussed. (Carstea-USGS)
W70-05940

NONSTEADY TWO-LAYER RADIAL FLOW TO WELLS,
Indiana Univ., Bloomington. Dept. of Geology.
Yaron M. Sternberg.
In: Groundwater, Proceedings of General Assembly of Bern (Sept-Oct 1967), International Association of Scientific Hydrology, Publication No 77, p 329-342, 1968. 14 p, 3 fig, 1 tab, 11 ref, append.

Descriptors: *Groundwater movement, *Aquifers, *Drawdown, Wells, Boundary processes, Laplaces equation, Hydraulic conductivity, Discharge (Water), Cost analysis, Steady flow, Unsteady flow.
Identifiers: Groundwater hydraulics.

Nonsteady flow toward a well penetrating two layers with different formation constants is analyzed for the constant drawdown case. The two layers are connected throughout the confined aquifer and cross flow from one layer to another can occur. The boundary value problem is solved using the technique of separation of variables and Laplace transformation. Exact solutions for the drawdown distribution around the well and the discharge at the face of the well are given for the nonsteady and steady cases. These solutions are in the form of a slowly converging infinite series and include an integral that must be evaluated numerically. The parameters appearing in these equations include the hydraulic conductivity of each of the layers and their thickness, the radius of the well, and the eigenvalues. The solutions presented can be used to determine the contribution of each layer to the total discharge. Decisions as to whether a well should be drilled deeper can be made knowing what the added discharge contribution is, and the cost involved in realizing the additional discharge. (Carstea-USGS)
W70-05944

NONSTEADY FLOW TO MULTIAQUIFER WELLS,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 02F.
W70-05956

APPLICATION OF ELECTRIC WELL LOGGING AND OTHER WELL LOGGING METHODS IN HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02F.
W70-06098

4C. Effects on Water of Man's Non-Water Activities

URBAN HYDROLOGY, STORM DRAINAGE, AND FLOOD PLAIN MANAGEMENT IN METROPOLITAN AREAS OF THE UNITED STATES,
American Public Works Association, Chicago, Ill.
Herbert G. Poertner.
Georgia Institute of Technology Water Resources Center Report, August 1968. 28 p. OWRR Project X-102.

Descriptors: *Water management (Applied), *Non-structural alternatives, *Planning, *Governments, *Urbanization, Storm runoff, Water supply, Legislation, Regulation, Zoning, Flood plain zoning, Reviews.
Identifiers: *Urban hydrology.

Current practices in urban hydrology, storm drainage, and flood plain management are reviewed. These practices have characteristics which not only limit solutions to present problems but contribute to future problems. An illustration is the opposition by land owners and tax authorities to flood plain zoning. One alternative to the present unsatisfactory state of management is to establish a program responsive to all segments of the population. Major limitations of present practices in engineering and design are deficiencies in knowledge of urban hydrology, lack of analyses of accumulated data, and ineffective use of data for producing optimum designs of integrated drainage systems. Problems of urban drainage are primarily institutional. Enabling legislation is needed for management of water in entire metropolitan areas by a single authority. Programs on federal, state, and local levels for correction of deficiencies within present flood plains and drainage systems need development to serve existing communities as well as those that may emerge in the surrounding area. (Knapp-USGS)
W70-05960

EFFECT OF CLIMATE, IMPOUNDMENTS, AND LAND USE ON STREAM SALINITY,
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
Harry B. Pionke.
Journal of Soil and Water Conservation, Vol 25, No 2, p 62-64, March-April 1970. 3 p, 4 fig, 7 ref.

Descriptors: *Water chemistry, *Water quality, *Climates, *Land use, *Oklahoma, Salinity, Streamflow, Surface-groundwater relationships, Infiltration, Evapotranspiration, Percolation, Flood control, Reservoirs, Precipitation (Atmospheric).
Identifiers: Climatic change.

Average salinity of the Washita River in Oklahoma increased substantially between 1954 and 1967. Among all variables studied, climatic changes appeared to exert the greatest influence on stream salinity levels. After correcting for the effect of climatic change, the same trend of salinity increase remained and appeared to be more closely related to changing land use than to the recent introduction of numerous impoundments at upstream locations. (Knapp-USGS)
W70-06102

HYDROLOGIC EFFECTS FROM URBANIZATION OF FORESTED WATERSHEDS IN THE NORTHEAST,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station; and Pennsylvania State Univ., University Park, Pa.
Howard W. Lull, and William E. Sopper.
U.S.D.A. Forest Serv. Res. Pap., NE-146, 1969. 31 p, 4 fig, 4 tab, 46 ref.

Descriptors: *Urbanization, *Watershed management, *Interception, *Infiltration, *Streamflow, Overland flow, Runoff, Peak discharge, Soil moisture, Soil compaction, Water quality, Pennsylvania.

Urbanization of forest areas tends to reduce interception, reduce infiltration and increase overland flow, reduce soil-moisture storage, reduce evapotranspiration, increase runoff, increase peak flows, and reduce water quality. Annual maximum peak flows, annual hydrologic responses, and annual runoff were found (from actual streamflow records) to increase with progressive urbanization. The percentage of summer rainfall that appeared as runoff and the hydrologic responses were greater for partially urbanized watersheds than for mostly forested ones.
W70-06157

THE GEORGES RIVER HYDRAULIC, HYDROLOGIC AND RECLAMATION STUDIES,
New South Wales Univ., Kingston (Australia).
For primary bibliographic entry see Field 02L.
W70-06177

PRELIMINARY MASTER PLAN FOR BOULDER CREEK FROM 24TH TO 30TH STREETS.
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-06189

MASTER PLANNING FOR STORM RUNOFF FOR NEW NORTH/SOUTH RUNWAY AND ENVIRONS--STAPLETON INTERNATIONAL AIRPORT.
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-06190

RECENT DEVELOPMENTS IN WATER LAW (LANDOWNER'S RIGHT TO MAKE REASONABLE USE OF PREMISES),
Clyde, Mecham and Pratt, Salt Lake City, Utah.
For primary bibliographic entry see Field 06E.
W70-06284

4D. Watershed Protection

SOIL CONSERVATION AND FLOOD CONTROL DISTRICTS.

Iowa Code Ann secs 467C.1-467C.6 (Supp 1969).

Descriptors: *Iowa, *Soil conservation, *Flood control, *Drainage districts, Local governments, Soil erosion, Drainage programs, Erosion control, Strip mines, Surface drainage, Levees, Legislation, Flood protection, Water control, Public health, Economics, Jurisdiction, Legal aspects, Administrative agencies, Financing, Assessments.

The board of supervisors of any county may establish districts for the purpose of soil conservation and flood control and may construct improvements and facilities to effect such purposes. Boards may cause any soil removed in mining operations to be replaced at the termination of such operations. Districts may combine in their functions activities affecting soil conservation, flood control and drainage. The word 'drainage' shall be deemed to include in its meaning soil erosion and flood control, and the term 'drainage district' shall include districts having the purpose of soil conservation or flood control. Financing procedures and assessments are provided. (Hubener-Florida)
W70-05990

POLICE POWER - LANDS - CONSERVATION COMMISSION (IMPROVEMENTS TO WATERBODIES ON PRIVATE PROPERTY).
Iowa Code Ann secs 108.7-108.10 (1949), as amended, (supp 1970).

Descriptors: *Soil conservation, *Watershed management, *Stream improvement, Accretion (Legal aspects), Conservation, Water conservation, Adoption of practices, Erosion control, Water resources development, State governments, Watershed management (Applied), Lakes, Stream erosion, Streams, Intermittent streams, Bank stability, Riparian land, Spillways, Streamflow, Regulated flow, Silting, Right-of-way, Easements, Administrative agencies legislation.
Identifiers: Artificial lakes.

With the consent of the owner, and subject to the approval of the Natural Resources Council, the Conservation Commission may enter private lands containing waterbodies draining into state-owned lakes and streams for the purpose of deepening, widening, filling, improving banks, constructing spillways, controlling erosion or providing structures to regulate stream flow. If the improvement is to improve the stream and not to prevent silting only, the agreement with landowner must include a public easement to the improved portions of the stream. Land created in areas under state jurisdiction remain under that jurisdiction until otherwise disposed of. In constructing artificial lakes on intermittent streams, the Commission cannot proceed with construction until soil conservation practices are in effect on at least 75 percent of the watershed or until the watershed land owners sign a soil conservation farm plan showing a willingness to carry on such practices. (Douberley-Florida)
W70-05993

SWAMPY FORESTS AND BOGS OF SIBERIA,
For primary bibliographic entry see Field 03B.
W70-06034

STORAGE AND DELIVERY OF RAINFALL AND SNOWMELT WATER AS RELATED TO FOREST ENVIRONMENTS,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02A.
W70-06038

SEDIMENT MEASUREMENT TECHNIQUES: C. ACCELERATED VALLEY DEPOSITS.
For primary bibliographic entry see Field 02J.
W70-06110

PRELIMINARY DETERMINATIONS OF SEDIMENT DISCHARGE IN SAN JUAN DRAINAGE BASIN, ORGANCE AND RIVERSIDE COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02J.
W70-06144

PUBLIC ATTITUDES TOWARD WATERSHED MANAGEMENT,
For primary bibliographic entry see Field 06E.
W70-06286

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION,
For primary bibliographic entry see Field 06E.
W70-06300

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

THE SOLUBILITY OF OXYGEN IN WINKLER REAGENTS USED FOR THE DETERMINATION OF DISSOLVED OXYGEN,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 07B.
W70-05996

BIODEGRADATION OF LINEAR ALKALATED SULFONATES.
New York Univ., Bronx.
For primary bibliographic entry see Field 05D.
W70-06058

AUTOMATIC METHODS OF SOLVENT EXTRACTION: BATCH EXTRACTION OF LOW CONCENTRATIONS OF NON-IONIC DETERGENT FROM WATERS,
Laboratory of the Government Chemist, London (England).
R. Sawyer, P. B. Stockwell, and K. B. E. Tucker.
The Analyst, Vol 95, No 1128, p 284-290, March 1970. 7 p, 6 fig, 3 tab, 4 ref.

Descriptors: *Chemical analysis, *Detergents, *Water pollution sources, Analytical techniques, Instrumentation, Laboratory tests.
Identifiers: Solvent extraction techniques.

An automatic system for solvent extractions of trace chemicals from aqueous samples is described. The system has been applied to the determination of traces of non-ionic detergent in sewage effluents and river waters. The method has been assessed by measuring the non-ionic detergent remaining in the sample by the manual method after automatic extraction. (Knapp-USGS)
W70-06120

ULTRAFILTRATION OF AQUATIC HUMUS,
Norsk Institutt for Vannforskning, Blindern.
Egil T. Gjessing.
Environmental Science and Technology, Vol 4, No 5, p 437-438, May 1970. 2 p, 1 fig, 1 tab, 9 ref.

Descriptors: *Humus, *Water analysis, *Filtration, *Separation techniques, Water treatment, Organic matter, Color, Taste, Odor, Water chemistry, Water quality, Colloids, Biochemistry, Analytical techniques, Chemical analysis.
Identifiers: Aquatic Humus.

Filtration of aquatic humus through Diaflo ultrafiltration membranes suggests that approximately 10% of the organic carbon and 1% of the colored matter have molecular weight below 1,000. The experiments indicate also that about 50 and 90% of organic carbon and color, respectively, are found in the fraction which is not penetrating the filter which is supposed to retain molecules larger than 20,000 in molecular weight. (Knapp-USGS)
W70-06123

SEA SURFACE AS A SINK OF EMANATION PRODUCTS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
G. Assaf, and J. R. Gat.
Earth and Planetary Science Letters, Vol 7, No 5, p 385-388, February 1970. 4 p, 1 fig, 1 tab, 10 ref.

Descriptors: *Aerosols, *Fallout, *Path of pollutants, *Sea water, *Tracking techniques, Dusts, Particle size, Precipitation (Atmospheric), Radioactivity techniques, Instrumentation.
Identifiers: Aerosol removal, Scavenging.

The decay products of radon (Rn-222) and thoron (Rn-220) are attached to submicron particles and serve as natural aerosol particle tracers. It has been shown that radioactive disequilibrium between radon and its shortlived decay products, as well as between Pb-212 and Bi-212, results from the presence of a sink for atmospheric aerosol particles. This property of the emanation products-aerosol system is used to study the process of removal of particles at the air-sea interfaces. The extent of equilibrium between Radon-222 and its shortlived daughter products was measured in air over the Eastern Mediterranean Sea. The uptake of aerosols by the sea surface is estimated from this measurement. A measurable scavenging effect was found only under stormy conditions when wave heights exceed 3 m. Lead-212 concentrations in the surface air are consistent with these scavenging effects. (Knapp-USGS)
W70-06137

ISOTOPIC COMPOSITION OF SULFATE IN RAIN WATER, PISA, ITALY,
Comitato Nazionale per le Ricerche Nucleari, Pisa (Italy). Laboratorio di Geologia Nucleare.
G. Cortecci, and A. Longinelli.
Earth and Planetary Science Letters, Vol 8, No 1, p 36-40, March 1970. 5 p, 2 fig, 1 tab, 15 ref.

Descriptors: *Sulfates, *Sulfur, *Stable isotopes, *Path of pollutants, Tracers, Tracking techniques, Atmosphere, Water chemistry, Air pollution.
Identifiers: Oxygen isotopes, Sulfur isotopes, Pisa (Italy).

The isotopic composition of both oxygen and sulfur has been measured in rain water sulfate over about one year. From the results obtained it is concluded that the main source of sulfate in rain water in Pisa is probably atmospheric oxidation of sulfur dioxide from industrial activity. (Knapp-USGS)
W70-06139

NEW DATA ON THE DIFFUSION OF IMPURITIES IN THE SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
R. V. Ozmidov, A. N. Gezentsvey, and G. S. Karabashev.
Transl from Izvestiya Akad Nauk SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 11, p 1191-1204, 1969. Atmospheric and Oceanic Physics, Academy of Sciences, USSR, Vol 5, No 11, p 686-693, November 1969. 8 p, 9 fig, 1 tab, 36 ref.

Descriptors: *Path of pollutants, *Diffusion, *Sea water, *Tracers, *Tracking techniques, Dye releases, Density stratification, Currents (Water), Surveys, Statistical methods, Diffusivity.
Identifiers: Eddy diffusion.

Some results of the study of turbulent diffusion of impurities in the sea using fluorescent tracers are reported. The equipment and method of the expeditionary work are described. Experiments were carried out in the Black Sea with both instantaneous and continuous tracer sources. Results are presented of measurements of tracer distribution along the axis and on cross sections of the diffusing streams, and also in diffusing patches. The tracer distribution, which depends on the scale of the phenomenon, is described by diffusion equations with calculated and assumed coefficients of diffusion. The sharp anisotropy of the diffusion process and the shear in the tracer located at different levels is explained by density stratification and the velocity gradient connected with the circulation currents in the upper layers of the sea. (Knapp-USGS)
W70-06158

POTENTIOMETRIC DETERMINATION OF AMMONIUM NITROGEN IN OILFIELD BRINES,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
A Gene Collins, Joe L. Castagno, and V. M. Marcy.
Environmental Science and Technology, Vol 3, No 3, p 274-275, March 1969. 2 p, 1 fig, 2 tab, 5 ref.

Descriptors: *Water analysis, *Ammonia, *Nitrogen, *Brines, Oil fields, Aqueous solutions, Analytical techniques, Chemical potential.
Identifiers: Ammonium nitrogen.

A rapid method for the determination of the ammonium nitorgen in saline waters was needed for petroleum geochemical and water pollution research. People at the Bureau of Mines developed a method using the reaction of formaldehyde with ammonium nitrogen and potentiometric determination of the strong acid produced. The ammonium nitrogen content of a saline water containing more than 3.9 mg of ammonium nitrogen per liter can be determined by the procedure in less than 30 minutes. A single laboratory relative standard deviation of 1% and a relative error of -2.8% were obtained when the concentration of ammonium nitrogen was 77.5 mg per liter in the presence of sodium chloride. (Knapp-USGS)
W70-06160

GEOCHEMISTRY OF SOME TERTIARY AND CRETACEOUS AGE OIL-BEARING FORMATION WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
For primary bibliographic entry see Field 02K.
W70-06178

AUTOMATED ANALYSIS FOR NITRATE BY HYDRAZINE REDUCTION,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Engineering Section.
L. J. Kamphake, S. A. Hannah, and J. M. Cohen.
Water Research, Vol 1, p 205-216, 1967. 6 fig, 3 tab, 9 ref.

Descriptors: *Automation, *Analytical techniques, *Nitrogen, *Nitrates, Water properties, Hydrogen ion concentration, Temperature, Ions, Sampling, Opacity, Sewage, Impoundments.
Identifiers: *Hydrazine reduction, Diazotization coupling reaction, Technicon AutoAnalyzer, Hydrazine sulfate.

Automated determination of nitrites and nitrates in water comprises two stages. First, the content of nitrites is determined by diazotization-coupling reaction; then, nitrate is quantitatively reduced with hydrazine sulfate to nitrite, the content of which is determined by the same diazotization reaction. The difference of the two determinations yields nitrite equivalent to nitrate of the sample. As many as 20 samples can be analyzed in 1 hour. Applicable range of the method is 0.05-10.0 milligrams/liter of either nitrite or nitrate nitrogen. The procedure has eliminated the difficulties encountered previously in reduction of nitrate in impounded waters by the use of zinc column. (Wilde-Wisconsin)
W70-06219

MANGANESE IN PROCESS WATER OF THE TEXTILE INDUSTRY (IN FRENCH),
R. S. Ingols.
Tribune CEBEDEAU, Vol. 20, p 271-272, 1966 (in French).

Descriptors: *Manganese, *Water supply, Heat exchangers, Distribution systems.
Identifiers: *Manganese oxides, *Staining, *Fabrics, Dyehouse wastes.

Hazards arising in textile plant from the presence, usually seasonal, of manganese in surface water used as a water supply, are discussed. Accumulated deposits of manganese oxides in heat exchangers and distribution systems can be released by pressure surges and result in staining of white cloth and in shade changes in some dyes. Five methods of treating the water supply are suggested. (Robinson and Livengood-North Carolina State Univ)
W70-06270

TEXTILE WASTE PROBLEMS,
R. S. Ingols.
Sewage and Industrial Wastes, Vol. 30, p 1273-1277, 1958.

Descriptors: *Biological treatment, *Trickling filters, *Activated sludge, Sulfides.
Identifiers: *Dyehouse wastes, Fiber wastes, Dyes, pH, Chromates, Synthetic detergents.

Starch, textile fibers, sulfides, and dyes are components of the wastes which should be reduced by biological treatment. High pH values, high salt concentrations, mildew resistant finishes, chromates, bleaching agents, and synthetic detergents are components which may interfere with biological treatment. Through design, it is possible to provide treatment of textile wastes by lagooning, trickling filters, or activated sludge. (Livengood and Robinson-North Carolina State Univ)
W70-06277

BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION,
South Dakota State Univ., Brookings.
Paul R. Middaugh.
Available from the Clearinghouse as PB-191 536, $3.00 in paper copy, $0.65 in microfiche. Completion Report April, 1970. 14 p. OWRR Project A-019-S DAK (1).

Descriptors: Water pollution sources, *Farm wastes, Bacteria E coli, Coliforms, Pathogenic bacteria, *Sewage bacteria, E coli, Enteric bacteria, Streptococcus bovis, Streptococcus faecalis, *Pollutant identification.

The initial or laboratory research phase of objectives were achieved. These were to improve the specificity, speed and reliability to bacteriological methods for determinging kinds and number of fecal bacteria in water resources. The major objective of distinguishing between human and animal sources of pollution was partially achieved by improved isolation of the rumen organism Streptococcus bovis. The objective of determining the survival of selected fecal coliform and fecal streptococcus in river water with and without filtration was completed in the M.S. Thesis study by Joseph Zerfas. He compared river water in laboratory flasks with environmental river exposure chambers to determine survival effect of temperature from 10 to 30C, decreased both coliform and streptococci equally with increased temperature. Added organic nitrogen fertilization of river from normal level 2.5 ppm N to 10 to 30 ppm N stimulated growth and lengthened survival time. Both kinds of organisms increased in survival in water with reduced dissolved oxygen compared to aerated water. In untreated river water fecal coliform bacteria lived longer than fecal streptococci, 7% and 0.1% survival respectively after 7 days. Water membrane filtered to remove protozoa gave 20% coliform and 100% streptococcus survival after 7 days. In M.S. Thesis study by L. Koupal, methods for detecting the rumen organism Streptococcus bovis resulted in a rapid, sensitive selective method using membrane filter for quantitative recovery from river water and selective medium incubated in 25% CO2+75% N2 gas grows S. bovis which is then detected by starch agar overlay. Only ruminants have S. bovis in numbers in feces so S. bovis in river survival studies was proven to be a useful tracer for ruminant pollution of surface waters. More rapid and sensitive methods for both indicator and pathogenic bacteria were being investigated when the project was terminated.
W70-06312

5B. Sources of Pollution

STUDY OF ESTUARINE POLLUTANT AND WATER QUALITY DISTRIBUTION IN THE NEW YORK CITY -- NEW JERSEY METROPOLITAN AREA.
Quirk, Lawler and Matusky, New York.
Interstate Sanitation Commission, September 1967. 63 p, 41 fig, 18 tab, 17 ref.

Descriptors: *Estuaries, *Water pollution effects, *Water pollution sources, *Mathematical models, *Hudson River, Model studies, Dissolved oxygen, Biochemical oxygen demand, Aeration, Reaeration, Path of pollutants, Water quality, New York, New Jersey, Urbanization, Cities.
Identifiers: Hudson Estuary.

One-dimensional, steady state models of the Arthur Kill-Raritan River-Raritan Bay-Newark Bay complex, and of the lower Hudson River-East River-Upper New York Bay complex were developed to yield tidal cycle, cross-sectional area-averaged concentrations of BOD and DO under equilibrium or steady state conditions. The model gives moderately good agreement with the three month summer averages of 1964. Parameters which required numerical evaluation for use in the model included flow, dispersion coefficient, unit rates of BOD decay, atmospheric reaeration and tidal exchange, waterway geometry and waste loading. Response of model-generated DO was more sensitive to changes in total loading than to any other single parameter. For the Hudson, the DO varied linearly with load, and less strongly with reaeration coefficient, decay coefficient, flow and dispersion coefficient. Total present loading on the Hudson River-Upper Bay-East River complex is approximately 1,800,000 pounds BOD/day. On the basis of present New Jersey DO standards, about 450,000 pounds/day can be assimilated by the Hudson River-Upper Bay system. Eighty percent treatment of current sources from both states will reserve about 20% of this capacity for future use. (Knapp-USGS)
W70-05937

ACCUMULATION OF ELECTRODIALYTICALLY SEPARATED PHYSICO-CHEMICAL FORMS OF Ru-106 BY MUSSELS,
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
Stjepan Keckes, Zvonimir Pucar, and Ljerka Marazovic.
Oceanology and Limnology, Vol 1, No 4, p 246-253, 1967. 2 fig, 2 tab, 11 ref.

Descriptors: *Mussels, *Physicochemical properties, *Electrodialysis, *Radioisotopes, *Water pollution sources, *Radioactive wastes, Sea water, Ion exchange, Metabolism, Fuels, Fallout, Salinity, Ions, Gamma rays, Radioactivity, Hydrogen ion concentration, Chlorides.
Identifiers: *Ruthenium-106, Uptake, Shells, Soft tissues, Reactors, Mytilus galloprovincialis Lam, Radiometric analyses, Nitrosyl-nitrato complex, Marine environments, Contamination.

Radioruthenium, either from reactor fuel processing plants or from weapon fallout, is among the most important artificial sources of marine environmental contamination. It has been found that nitrosyl and chloride complex forms of ruthenium, in which it occurs most frequently as radioactive waste, are composed of several physico-chemical forms fairly stable in sea water and defined by their elecrophoretic and chromatographic mobility. Ruthenium-106 nitrosyl-nitrato and chloro complexes were separated in sea water by elecrodialysis through ion-exchange membranes by a 5-compartment electrodialytic cell. In parallel experiments the biological uptake and loss of obtained 'anionic,' 'cationic' and 'neutral' fractions were tested. Using mussels, Mytilus gallo-provincialis Lam, it was shown that the uptake activity is always higher in soft tissues than in shells. The uptake rate of ruthenium chloride complexes was higher than that of ruthenium nitrosyl-nitrato complexes. The electro-dialytically separated fractions originating from the same stock gave significantly different uptake curves indicating different physico-chemical forms in the fractions. The differences in the loss of incorporated activity showed that various fractions were not bound in the animals in the same manner. (Jones-Wisconsin)
W70-05988

RESISTANCE TO CHLORINATED HYDROCARBON INSECTICIDES IN THREE SPECIES OF FRESHWATER FISH,
Mississippi State Univ., State College.
Denzel E. Ferguson, Dudley D. Culley, William D. Cotton, and Ross P. Dodds.
BioScience, Vol 14, No 11, p 43-44, 1964. 1 tab, 4 ref.

Descriptors: *Pesticide toxicity, Chlorinated hydrocarbon pesticides, Resistance, Fish behavior, DDT, Aldrin, Dieldrin, Endrin, Bioassay.
Identifiers: Golden shiners, Bluegill, Green sunfish, Toxaphene, Tolerance, Gambusia affinis.

Resistant and non-resistant populations of golden shiner, bluegill and green sunfish were exposed to five chlorinated hydrocarbon insecticides (DDT, toxaphene, aldrin, dieldrin, endrin). Resistant populations--those reared in insecticide-contaminated waters--were resistant to all test insecticides except DDT (based on 36-hour median tolerance limit (TLm)). Non-resistant population TLm's ranged from 1.5 ppb (bluegills--endrin) to 80 ppb (golden shiners--aldrin); resistant population TLm's ranged from 22 ppb (green sunfish--DDT) to 4750 ppb (golden shiners--aldrin). Observations of fish in aquaria indicated a respiratory mode of action for the toxicants used. Preliminary tests on seasonal changes in resistance indicate higher tolerances in March-April and in June-July. (Voigtlander-Wisconsin)
W70-05992

PROVISIONAL TIME-OF-TRAVEL FOR ILLINOIS STREAMS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02E.
W70-06035

AGRICULTURAL POLLUTION OF WATER BODIES,
Agricultural Research Service, Washington, D.C.
William M. Edwards, and Lloyd L. Harrold.
The Ohio Journal of Science Vol 70, No 1, p 50-56, Jan 1970.

Descriptors: *Water pollution, *Farms, *Livestock, *Phosphorus, *Nitrates, *Pesticides, *Soil conservation, Runoff, Erosion, Percolation, Sediment, Waste.
Identifiers: Lake Erie, Barnyard, Solids, Liquids.

Pollution of Ohio's water bodies is of growing public concern; industrial, urban, and rural sources are becoming the subject of critical examination. Rural sources are soil sediment, plant nutrients, animal waste, and pesticides. Pesticides and phosphorus are absorbed rapidly and strongly to soil particles. Therefore reductions in sediment, phosphorus, and pesticide pollution are achieved by soil-erosion-control farming practices. More acres need to be brought under erosion-control practices. Nitrates dissolve in water and are carried by surface flow to streams and lakes, and by percolating water to underground aquifers. Increases in the use of nitrogen fertilizer, in evidence almost everywhere, could result in serious contamination of water bodies, if soil enrichment greatly exceeds the crop demand. Areas where large-scale livestock and poultry production is concentrated are also potential sources of serious pollution. In Ohio, animal-waste pollution problems are being studied at The Ohio State University, and movement of pollutants in surface and subsurface waters on drainage plots near Castalia are being studied by the Ohio Agricultural Research and Development Center and on agricultural watersheds by USDA Agricultural Research Service at Coshocton, Ohio. (Harrold-USDA, ARS)
W70-06041

PHYSICAL AND ECONOMIC FACTORS ASSOCIATED WITH THE ESTABLISHMENT OF

STREAM WATER QUALITY STANDARDS, VOLUME I,
Iowa State Univ., Ames. Engineering Research Inst.
M. D. Dougal, E. R. Baumann, and J. F. Timmons.
Available from the Clearinghouse as PB-191 167, $3.00 in paper copy, $0.65 in microfiche. Completion Report ISU-ERI-Ames-64400, April 1970. 343 p. OWRR Project A-001-IA.

Descriptors: *Economics, *Mathematical models, Path of pollutants, *Waste assimilative capacity, *Water quality, *Water pollution, Biochemical oxygen demand, Computers, Dissolved oxygen, Quality standards, Rivers, Sewage treatment, Simulation, Streams.

A comprehensive study is reported of water pollution control and stream water quality as they relate to the establishment of stream and effluent standards. The ability of Iowa streams to assimilate organic wastes was determined on a state-wide basis, with three hydrologic-water quality regions being identified: Ideal, Good, and Poor. Quantitative values were assigned for low flow discharges in each region. The preliminary results indicate that the BOD loading in the streams must be limited to 10 - 15 mg/l to maintain the established dissolved oxygen standard of 4 mg/l. The physical characteristics of effluents from typical waste treatment processes were determined and related to mathematical models for BOD progression. A more refined BOD model was developed. A case study of the Skunk River at Ames revealed the nature of the response of an Iowa stream to discharge of effluents from a water pollution control plant. A digital computer model was developed for simulating, verifying and forecasting stream water quality. The results indicate three major factors influence stream quality: oxidation of the carbonaceous organic wastes contained in effluents, nitrification of nitrogenous compounds, and the effect of nutrient levels in causing a substantial algal response. The economic value of water pollution control was evaluated for the City of Ames. Present annual expenditures will double or triple in the future depending on the desired level of stream water quality.
W70-06094

EFFECT OF CLIMATE, IMPOUNDMENTS, AND LAND USE ON STREAM SALINITY,
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
For primary bibliographic entry see Field 04C.
W70-06102

CONCENTRATION OF DDT BY SEDIMENTED POLLUTING OILS,
Michigan Univ., Ann Arbor. Dept. of Industrial Health.
Rolf Hartung, and Gwendolyn W. Klingler.
Environmental Science and Technology, Vol 4, No 5, p 407-410, May 1970. 4 p, 4 fig, 1 tab, 9 ref. PHS Grant No ES-00147.

Descriptors: *DDT, *Oily water, *Path of pollutants, *Solubility, *Bottom sediments, Oil-water interfaces, Water pollution effects, Water chemistry, Oil wastes.
Identifiers: DDT partitioning (Oil-water).

The occurrence of sedimented oils is widespread in areas with a history of repeated oil pollution. Concentrations of 0.5% pretroleum oils in these sediments are a common situation. These oils can act as partitioners and concentrate nonpolar substances from water. For DDT, the partitioning coefficient between mineral oil and water was found to be 1.30 million. The partitioning coefficient for DDT and sedimented mineral oil was found to be 1.08 million in an artificial stream in the laboratory. In the environment (Detroit River, Mich.) regressions of DDT concentration in sediments, on oil concentration in sediments, indicate a significant relationship. Estimated partition coefficients for DDT between water and sedimented oils in the Detroit River sediments were calculated to be at least 1.45 million. The biological implications of the concentrating behavior of these oils should be investigated. (Knapp-USGS)
W70-06122

MICROBIOLOGICAL FACTOR IN ACID MINE DRAINAGE FORMATION: A PILOT PLANT STUDY,
Carnegie-Mellon Univ., Pittsburgh, Pa.
For primary bibliographic entry see Field 05G.
W70-06128

ADSORPTION OF COPPER BY CLAY MINERALS, HUMIC ACID AND BOTTOM MUDS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Aquatic Weed Control.
For primary bibliographic entry see Field 02K.
W70-06135

ISOTOPIC COMPOSITION OF SULFATE IN RAIN WATER, PISA, ITALY,
Comitato Nazionale per le Ricerche Nucleari, Pisa (Italy). Laboratorio di Geologia Nucleare.
For primary bibliographic entry see Field 05A.
W70-06139

OIL ON THE SEA.
Massachusetts Inst. of Tech., Cambridge, Mass.

Proc of Symp on the Scientific and Engineering Aspects of Oil Pollution of the Sea, sponsored by Mass Inst Technol and Woods Hole Oceanogr Inst, held at Cambridge, Mass, May 16, 1969, Hoult, David P., Editor, New York, Plenum Press, 1969. 114 p.

Descriptors: *Oily water, *Offshore platforms, *Water pollution sources, *Water pollution control, Oil fields, Oil industry, Legal aspects, Legislation, International waters, Oil wells, Water pollution treatment.
Identifiers: Oil spills.

In the last decade, changes in the scale of operations required to find and transport oil have led to a pollution problem of major proportion: oil on the sea. These changes occurred slowly, and the change in magnitude of the possibilities for pollution went unrecognized until a series of dramatic accidents recently gave the problem wide-spread public notice. The Torrey Canyon and Santa Barbara episodes are discussed. A summary is given of our current understanding of the problem of oil on the sea. The first three articles deal with the biological effects of oil spills. The next four articles are discussions of various engineering problems which arise in attempting to deal with spilled oil. The development of supertankers for transporting oil and the legal and legislative government attempts to cope with this problem are discussed. (Knapp-USGS)
W70-06155

POLLUTION FACTORS AND TREATMENT OF TEXTILE WASTE WATERS,
P. W. Sherwood.
Textile Manufacturer, Vol. 91, p 235-238, 1965. 1 table.

Descriptors: *Oil, *Emulsions, Distillation, Coagulation, Heat, Filtration.
Identifiers: *Gravity separator, *Electrical demulsification, Cottrell demulsification flue gas.

The degree to which clean-up must be practiced is set by such various considerations as nature of the nuisance, the size of the refining operation, the volume of the receiving water, the proximity of downstream water consumers, as well as considerations of downstream fish life, characteristics of river flow, and temperature. A classification of aqueous contaminants arising from textile operations will break down to the following chief categories: oil, both free and emulsified; acid or alkaline solutions; inorganic salts; organic acids; and phenols or soaps of these compounds; suspended solid that increase the turbidity of the waters; and various phenolic, naphthenic, and organic sulphur and nitrogen compounds which are toxic to marine life and give rise to unpleasant taste and odour of the water. For removal of oily impurities, it is general practice to provide at least three different separator systems-for contaminated storm water, for contaminated cooling water, and for process water. For decontamination of separable oil containing water, gravity separators are in universal use. Treatment of oil-water emulsions may be supplemented by electrical processing and to a lesser extent by filtration or even contrifuging. Application of heat is usefully employed to break up a great variety of emulsions. Electrical demulsification is carried out by passing the emulsion between a pulsating direct current at high potential. (Robinson-North Carolina State Univ)
W70-06273

STREAM POLLUTION AND EFFLUENT TREATMENT, WITH SPECIAL REFERENCE TO TEXTILE AND PAPER MILL EFFLUENTS,
For primary bibliographic entry see Field 05D.
W70-06274

WASTE WATERS FROM THE WOOL INDUSTRY (IN RUSSIAN),
N. A. Lukinych.
Sanitarnaia Tekhnika Vol. 3, 1954. p 137-160.

Descriptors: *Waste Treatment, Neutralization, Centrifugation, Alkalinity.
Identifiers: *Waste water analysis, *Fiber production wastes, *Wool treatment wastes, *Wool grease recovery, Wool wastes, Spinning wastes, Weaving wastes, Wool grease, Acid treatment.

An investigation is described of the waste waters from a number of works of the wool industry; these are divided into three groups, those dealing with crude wool, spinning and weaving works, and works treating the prepared material. The water demand of 15 processes and analyses of their waste waters are given. Waste washing waters are alkaline, have high contents of suspended matter and grease, and have a high BOD. Waste waters from factories dealing with crude wool must be treated for removal of fibrous material and grease. Processes for removal of grease are described and a combination of centrifuging with acid treatment is recommended. (Livengood and Mattox-North Carolina State Univ)
W70-06280

BACTERIOLOGICAL WATER QUALITY ANALYSES OF METHODS FOR DETECTING FECAL POLLUTION,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 05A.
W70-06312

5C. Effects of Pollution

THE ECOLOGY OF PERIPHYTON IN WESTERN LAKE SUPERIOR: PART I - TAXONOMY AND DISTRIBUTION,
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 02H.
W70-05958

THE EFFECTS OF ELEVATED TEMPERATURE UPON AQUATIC INVERTEBRATES--A REVIEW OF LITERATURE RELATING TO FRESH WATER AND MARINE INVERTEBRATES,
John Hopkins Univ., Baltimore, Md. Dept. of Geography.

Loren D. Jensen, Robert M. Davis, Arthur S. Brooks, and Caldwell D. Meyers.
Available from Edison Electric Institute, 750 Third Avenue, New York, N.Y. 10017, as EEI Publication No 69-900, Price: $4.00. Edison Electric Institute Research Project No 49, Report No 4, September , 1969. 232 p, 6 tab, 14 fig, 384 ref. EEI Contract PG 49.2907.

Descriptors: *Reviews, *Thermal pollution, *Aquatic animals, *Water pollution effects, Heated water, *Aquatic environment, *Environmental effects, Ecosystems, Aquatic insects, Fish physiology, Crustaceans, Crabs, Lobsters, Crayfish, Isopods, Amphipoda, Copepods, Mollusks, Oysters, Clams, Mussels, Snails, Annelida.
Identifiers: Arachnida, Chelicerata, Sea spiders, Horseshoe crabs, Water mites, Scallops, Shipworms, Bryozoa, Ctenophora, Coelenterata, Roundworms, Echinodermata, Flatworms.

Literature directly concerning the effect of elevated temperatures upon both freshwater and marine invertebrates has been reviewed. A bibliography of 384 references has been included. The review has been limited to major invertebrate groups and does not, because of the lack of published data in some areas, include a uniform treatment of all the groups. The review was written as a source of information for the non-professional biologist. There are three sections. The first introduces the role of temperature in the biology-ecology of the aquatic ecosystem and the effect of temperature on the physio-chemistry of the aquatic environment. Section two is an introduction to major invertebrate groups, their morphology and life history, and a review of the published information on the effect of elevated temperatures on the whole animal and the effect on reproduction and development. The third section presents conclusions and interpretations drawn from the published data, including, brief presentations on: heat synergisms, order and duration of temperature response, physiological acclimation, short term effect of heat on critical physiological processes, species--individual reaction to heat, thermal tolerance to life stages, speciation resulting from thermal stress, thermal influences upon mechanisms of genetic variation, heat injury summary, and thermal influences upon food chain interrelationships.
W70-05962

EFFECT OF SUBLETHAL DDT ON THE LATERAL LINE OF BROOK TROUT, SALVELINUS FONTINALIS,
Carleton Univ., Ottawa (Ontario). Dept. of Biology.
John M. Anderson.
Journal Fisheries Research Board of Canada, Vol 25, No 12, p 2677-2682, 1968. 2 fig, 9 ref.

Descriptors: *Fish physiology, *Trout, *DDT, Behavior, Fish, Vibrations, Chlorinated hydrocarbon pesticides.
Identifiers: *Neurophysiology, Brook trout, Sublethal concentrations, Electrophysiology.

The normal multifiber response of the lateral line nerve to disturbance generated by a falling drop of water consists of a train of relatively large spikes. Responses are clearly distinguishable from spontaneous activity, are of short duration and apparently modified by water temperature (0.05 seconds at 5C; 0.2 seconds at 14C), and have a frequency of about 400 impulses per second. 24-hour exposure to sublethal DDT concentrations (0.1, 0.2, and 0.3 ppm) resulted in a marked prolongation of the response, especially at lower temperatures (4 to 5C); no differences in frequency of responses were noted. Tests suggest that the observed negative temperature coefficient of the DDT effect on the lateral line nerve may be indicative of the effects of DDT on the entire sensory system. Experimental observations are discussed in light of other reported physiological and behavioral data. (Voigtlander-Wisconsin)
W70-05977

THEORETICAL ASPECTS OF THE COMPARABILITY OF PRODUCTIVITY DATA,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 07B.
W70-05978

ON THE PRODUCTIVITY OF FIVE DANISH WATERS,
For primary bibliographic entry see Field 02H.
W70-05979

CHIRONOMIDS AND LAKE NUTRIENTS IN FLORIDA,
Florida State Board of Health, Vero Beach. Entomological Research Center.
Maurice W. Provost.
Sewage and Industrial Wastes, Vol 30, No 11, p 1417-1419, 1958. 4 ref.

Descriptors: *Midges, *Lakes, Nutrients, Florida, Pest control, Insect control, Eradication (Pests), Chemcontrol, Water pollution effects, Pesticides, Phytoplankton.
Identifiers: *Midge Investigation Program (Fla), *Chironomid midges, Glyptotendipes paripes, Lake May (Fla), Lake Lulu (Fla), Bloodworms, Winter Haven (Fla), Blind mosquitos, BHC, EPN, Sand bottoms.

Because of nuisance levels of chironomid midges in the area of Winter Haven, Florida, a survey was conducted to determine (1) the chironomid species present, (2) the association between the species and environments for the larvae, and (3) the association between chironomid production and the disturbances of the natural conditions in the lakes by cultural activities. Early attempts at chemical control of chironomid larvae were unsuccessful owing to development of larvicide resistance to both BHC and EPN. 13 lakes in the survey ranged from undisturbed (no homes, industries, sewage plants) to lakes having several possible nutrient sources, including urban development, canning plants, citrus groves, septic tanks, and sewage plants. Preliminary results indicate that major pest, Glyptotendipes paripes, breeds on sand substrate irrespective of depth and other limnological variables (transparency, pH, alkalinity). Food of G paripes consisted of planktonic algae; feeding is non-selective and amounts of algae in stomachs were proportional to planktonic densities in the lake. On the basis of preliminary results, research has been initiated on biological studies of midges, comparative limnology of the selected lakes and control studies. (Voigtlander-Wisconsin)
W70-05980

BIOLOGICAL AND CHEMICAL SIGNIFICANCE OF SURFACE MICROLAYERS IN AQUATIC ECOSYSTEMS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology; and Ryckman, Edgerley, Tomlinson and Associates, Clayton, Md.
B. Parker, and G. Barsom.
BioScience, Vol 20, No 2, p 87-93, 1970. 75 ref.

Descriptors: *Lakes, *Oceans, *Surfaces, *Air-water interfaces, Seston, Oil, Oil-water interfaces, Aquatic environment, Surfactants, Water pollution sources, Retardants, Alcohols, Pesticides, Microorganisms, Phytoplankton, Toxins, Fish, Wildlife, Sampling, Red tide, Human diseases, Nitrogen, Phosphorus, Evaporation control.
Identifiers: *Microlayers, Slick hazards, Surface films, Oil spills, Outboard motors, Evaporation suppressant, Buoyant cells, Long-chain alcohols, Gas vacuoles, Neuston microorganisms, Microlayer sampling, Torrey Canyon oil spill, Aitken particles, 'Giant' hygroscopic nuclei, Foam aerosol content.

The objective is to establish the ecological importance of sea and freshwater basins' surface microlayers. The thickness of this water film varies from a molecular monolayer to more than 1 millimeter, but the minute horizontal dimensions of this, one might say, 'hydroepidermis' is totally disproportionate to its ecological significance. The zone near the air-water interface accumulates both airophobic and hydrophobic materials, including natural oils, seston, other buoyant cells, synthetic surfactants, long-chain alcohols, biocides, and many members of neustonic biota. In many instances surface microlayers carry much higher concentration of toxic substances than water at a few centimeters depth, a fact that may often be responsible for the deleterious effects of eradicants and detergents on the inhabitants of lakes, rivers, and seas. (Wilde-Wisconsin)
W70-05983

IN SEARCH OF A CLEAR SOLUTION,
David Jenkins.
Sweden Now, Vol 3, No 3, p 24-26, 44, 1969. 4 fig.

Descriptors: *Eutrophication, *Water pollution sources, *Water pollution effects, *Water pollution control, *Lakes, Costs, Waste treatment, Water supply, Aeration.
Identifiers: Reed cutting, Aluminum sulphate treatment, Government subsidies, Sweden.

Some of Sweden's water pollution problems consist of untreated waste discharges into many of its 100,000 lakes, rendering them unsuitable for recreation. The pollution sources of Lake Trummen were stopped, but the lake was 'dead'--strangled with plant growth, and a 16-foot sediment blanket. The attempted cure was to pump out the top 20 inches of sediment which contain most of the pollutants. Remedial attempts in other projects are: direct aeration with air pumps, aeration by pumping bottom water through an artificial stream and returning it to the bottom, and aluminum sulphate treatment, which mixes with phosphorus in the water, settles to the bottom, forming a harmless blanket. Reed mowing is being tried on Lake Hornborga, its level lowered to produce arable land but leaving the lake shallow, overgrown, and oxygen deficient. The government is subsidizing waste treatment plants at $8 million annual rate, and subsidies for industrial pollution control are proposed which would cover up to 25% of the capital cost. The pollution of the Baltic Sea is increasing and becoming an international concern. (Powers-Wisconsin)
W70-05986

WASTEWATER POLLUTION AND GENERAL EUTROPHICATION OF A HYDROELECTRIC IMPOUNDMENT,
Department of Health, Rotorua (New Zealand).
L. W. Reid.
Journal of the Water Pollution Control Federation, Vol 38, No 2, p 165-174, 1966. 4 fig, 1 tab, 13 ref.

Descriptors: *Reservoirs, *Water pollution sources, *Diseases, Sewage bacteria, Sewage, Phosphorus, Enteric bacteria, Thermal stratification, Hydrogen ion concentration, Plankton, Temperature.
Identifiers: *New Zealand, Hepatitis, Gastroenteritis, Hydroelectric impoundments, Plankton blooms, Elodea canadensis.

The city of Mangakino obtains its water supply from Lake Maraetai, a hydroelectric impoundment in the Waikato River Basin, New Zealand. The city's sewer outfall is one mile below the intake. Outbreaks of infective hepatitis during 1958-1959 prompted a study to determine the relationship between the disease and pollution of the reservoir. Temperature readings revealed marked flowthrough below 20 feet during thermal stratification, and that the wastewater was warmer than the lake, causing it to rise to the surface. A dye test confirmed this and indicated that surface water movement was influenced by wind, independent of the general direction of flow through the lake. Extending the sewer outfall from just below the surface to a depth of 50 feet is expected to make surface pollution less likely, but still possible under isothermal conditions. In 1961, a prolific plankton bloom occurred in the lake. Major nutrient sources

were traced to cultural development of the Waikato River draingage basin, aggravated by ponding of water in hydroelectric reservoirs, and by wastewater enrichment of surface waters. Extensive establishment of Elodea canadensis is expected to stabilize the ecology, diminishing future plankton blooms. (Haskins-Wisconsin)
W70-05987

BENTHIC MACROINVERTEBRATES AND PERIPHYTON.
Midwest Benthological Society.

Select and Current Bibliographies, 1967. 23 p.

Descriptors: *Benthic flora, *Benthic fauna, *Invertebrates, *Periphyton, *Bibliographies, Oligochaetes, Crustaceans, Diptera, Mollusks, Ecology, Technology.
Identifiers: *Macroinvertebrates, *North American benthos, Turbellaria, Polychaeta, Crustacean zooplankton, Plecoptera, Ephemeroptera, Odonata, Trichoptera, Megaloptera, Aquatic Hemiptera, Aquatic Coleoptera, Chaoboridae, Chironomidae.

This is a bibliography of North American benthic macroinvertebrates and periphyton. It includes primarily papers published in 1967 and those 1965 and 1966 publications not included in the preceeding two bibliographies. Papers concerning species or genera not occurring in North America were excluded. The section titled 'General Aquatic Ecology' contains references that could not be conveniently placed in a specific group. Members of the Literature Review Committee are listed in the Table of Contents with their contributions. Eugene W Surber, Henry H Howell, and H F Clifford made sizable contributions to the sections on General Aquatic Ecology, and Techniques. The section titles are: Periphyton, Turbellaria, Oligochaeta and Polychaeta, Crustacea, Crustacean Zooplankton, Plecoptera, Ephemeroptera, Odonata, Trichoptera, Megaloptera, Aquatic Hemiptera, Aquatic Coleoptera, Diptera--Chaoboridae, Diptera--Chironomidae, Other Aquatic Diptera, Mollusca, General Aquatic Ecology, and Techniques. (Jones-Wisconsin)
W70-05989

AN ATTEMPT TO DETERMINE THE PRIMARY PRODUCTION OF THE GREEN SULPHUR BACTERIA, CHLOROBIUM LIMICOLA NADS, (CHLOROBACTERIACEAE),
Bialystok Medical Academy (Poland). Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-05991

KETHIKAN GATEWAY BOROUGH: WATER AND SEWAGE SURVEY.
Alaska State Housing Authority, Anchorage.

Available from the Clearinghouse as PB-189 139, $3.00 in paper copy. $0.65 in microfiche. May 69, 129p.

Descriptors: *Water supply, Municipal water, Water requirements, *Sewage treatment, *City planning.
Identifiers: Kethikan Gateway, Alaska.

The document is concerned with serious water and sewage problems in many areas within the Borough. The report provides a detailed engineering survey, setting forth in nontechnical language, information which would serve as a long range water and sewerage plan.
W70-06033

MARINE DISPOSAL OF SEDIMENTS FROM BELLINGHAM HARBOR AS RELATED TO SOCKEYE AND PINK SALMON FISHERIES,
International Pacific Salmon Fisheries Commission, Westminister (British Columbia).
J. A. Servize, R. W. Gordon, and D. W. Martens.
International Pacific Salmon Fisheries Commission, Progress Report No. 23, 1969. 38 p., 9 ref, 9 tab, 9 fig.

Descriptors: *Sockeye salmon, *Pink salmon, Disposal, Marine fisheries, Hydrogen sulfide, Sediment distribution, *Bottom sendiments, *Pulp wastes, Fishkill, Dispersion, Biochemical oxygen demand, Turbidity, Toxicity.
Identifiers: Bellingham Bay, Washington, *Pulp fibers.

A recent proposal for dredging and marine disposal of sediment from Whatcom Waterway, Benningham was of concern to fisheries agencies since the proposed disposal area was utilized by several fish stocks. Laboratory study indicated that two types of sediment were involved. Sediment from the inner harbor consisted primarily of putrefying pulp fibers which exerted a significant oxygen demand, created substantial turbidity, and were toxic to juvenile sockeye salmon because of their hydrogen sulfide content. Various methods of widespread dispersal to dilute the sediment appeared impractical, and it was concluded that land disposal of inner harbor sediment would be necessary to protect fish stocks. Sediment from the outer harbor was a natural silt, no containing hydrogen sulfide, but exerted an oxygen demand and created a highly turbid mixture which settled very slowly. Hydraulic dredging and local disposal adjacent to the outer harbor was recommended. (Sjolseth and Katz-Washington)
W70-06043

TEMPERATURE-INDUCED CHANGES IN THE OXYGEN EQUILIBRIUM CURVE OF THE BLOOD OF THE BROWN BULLHEAD, ICTALURUS NEBULOSUS,
Oregon Univ., Eugene. Dept. of Biology.
Gordon C. Grigg.
Comparative Biochemistry and Physiology, Vol 28, p 1203-1223, 1969. 6 tab, 8 fig, 38 ref. NSF Grant GA-422.

Descriptors: Thermal stress, *Water temperature, *Bullheads, Acclimatization, *Fish physiology, *Animal metabolism, *Hydrogen ion concentration.
Identifiers: *Hemoglobin, Ictalurus Nebulosus, *Blood, Plasma, Erythrocyte, Temperature adaptation, *Oxygen equilibrium curves, Oxygen affinity.

The affinity of blood for oxygen is dependent on temperature, which would seem to present a disadvantage to those fishes which encounter large seasonal temperature changes. Considering the well-known acclimatory abilities of many fishes, it would seem reasonable to propose the occurrence of seasonal modification of blood oxygen equilibria to compensate for changes in temperature. In Ictalurus nebulosus, blood from one group of fish acclimated at 24C showed a consistently higher oxygen affinity compared with a group acclimated at 9C, when measured at the same temperature. This shift, accompanying thermal metabolic acclimation, minimized the effect of temperature on oxygen affinity. The shift did not persist when dilute solutions of hemoglobin were studied. No changes with acclimation were seen in the multiple hemoglobin pattern nor in blood pH. The erythrocyte, rather than the plasma, appears to be the site of modification. (Sjolseth and Katz-Washington)
W70-06044

THERMAL COMPENSATION OF RESPIRATORY ENZYMES IN TISSUES OF THE GOLDFISH (CARASSIUS AURATUS L.),
Duke Univ., Beaufort, N.C. Marine Lab.
Richard S. Caldwell.
Comparative Biochemistry and Physiology, Vol 31, p 79-93, 1969. 6 tab, 1 fig, 37 ref. NSF Grant G-17669.

Descriptors: Thermal stress, *Acclimatization, Water temperature, Enzymes, *Fish physiology, Fish behavior, Animal metabolism.
Identifiers: *Thermal compensation, *Temperature adaptation, Goldfish, *Cytochrome oxidase, Carassius auratus, ATP, Mitochondria, *Election transport enzymes, ADP, Fish gills.

Chtochrome oxidase activity, determined over the range 10-40C was higher at all assay temperatures in brain, gill and muscle homogenates of 10C-acclimated goldfish than of 30C-acclimated fish, but was only higher in liver homogenates when assayed at 30 and 40C. Thermal compensation of gill cytochromeoxidase did not appear to involve a significant increase in the mitochondrial content of the cells. Cytochrome oxidase, succinate-cytochrome-c reductase and NADH-cytochrome-c reductase activities were all higher in gill mitochrondrial preparations from cold-acclimated fish. The concentration of cytochrome-c1 was reduced in gill mitochondria of cold-compared to warm-acclimated goldfish. However, the concentrations of cytochromes-aa3, -b and c were similar to these two groups. It is suggested that mitochondrial electron transport systems compensate to the degree necessary to meet changing ATP demands of goldfish exposed to new environmental temperatures. (Sjolseth and Katz-Washington)
W70-06045

THE FAILURE OF OXYGEN TRANSPORT IN A FISH AT LOW LEVELS OF AMBIENT OXYGEN,
Sydney Univ. (Australia). School of Biological Sciences.
Gordon C. Grigg.
Comparative Biochemistry and Physiology, Vol. 28 p 1253-1257, 1969. 2 tab, 2 fig, 7 ref. NSF Grant GA-422.

Descriptors: *Fish physiology, Oxygenation, Bullheads, Oxygen requirements, Water temperature.
Identifiers: *Oxygen transport, *Blood, *Gills, Ambient oxygen tension, *Ictalurus nebulosus, Acclimation temperature.

Complete deoxygenation of arterial blood results in the failure of oxygen consumption in brown bullheads (Ictalurus nebulosus) at low levels of ambient oxygen. The arterial deoxygenation apparently results from inability of the blood to load oxygen across the diffusion barrier of the gills, since gill ventilation and perfusion continue after oxygen uptake ceases. The ambient oxygen tension at which this occurs differs appropriately in two groups of bullheads known to have different blood oxygen affinities as a result of thermal acclimation. The oxygen affinity of the blood is therefore strongly implicated as a factor limiting oxygen uptake at low levels of ambient oxygen. (Sjolseth and Katz-Washington)
W70-06046

THE CHEMICAL COMPOSITION OF THE WISLOK IN THE REGION OF KROSNO AND ITS POLLUTION WITH HEAVY METALS (Cu, Cr, Ni), (IN POLISH),
Polish Academy of Sciences, Krakow. Lab. of Water Biology.
Maria Bombowna, and Stanishlaw Wrobel.
Acta Hydrobidogica, Vol 10, No. 4, p 439-452, 1968. 2 tab, 6 fig, 6 ref.

Descriptors: Industrial wastes, Water pollution effects, Self-purification, Chromium, Copper, *Heavy metals, *Water quality, Water chemistry, On-site investigations, *Aquatic populations, Dissolved oxygen, Sphaerotilus
Identifiers: *Cyanides, Nickel, Poland, *Wislok River.

The report describes the pollution of the water in the Polish river Wislow in the region of Krosno with heavy metals (Cu, Cr, Ni) and cyanides in relation to the chemical composition of the water. By analysis carried out at various water levels three times a year it was established that this kind of pollution explained why the section of the river polluted with the sewage from the stream above was so very long.

The comparison of the results of hydrochemical and hydrobiological investigations showed that a high concentration of heavy metals and cyanides transformed the river into desert, while even a low one affected most unfavorably the communities involved in self-purification. (Sjolseth and Katz-Washington)
W70-06047

A CHARACTERISTIC OF THE APPEARANCE OF BOTTOM FAUNA IN THE RIVER WISLOK NEAR KROSNO, (IN POLISH),
Polish Academy of Sciences, Krakow. Lab. of Water Biology.
Jerzy Zieba.
English Summary. Acta Hydrobiologica, Vol. 10, No. 4, p. 453-469, 1968. 1 tab, 1 fig, 13 ref.

Descriptors: *Benthic fauna, Density, *Industrial wastes, Chromium, Copper, *Community development, Domestic wastes, Oligochaetes, Aquatic populations, Tubificids, *Water pollution effects, Sphaerotilus, Dissolved oxygen, Aquatic insects, On-site investigations, Environmental effects water quality, *Heavy metals.
Identifiers: *Nickel, *Cyanide, *Poland Wislow River.

The density of settlement and also in a certain measure, the composition of bottom fauna depended in most of the investigationed localities on the kind and concentration of impure waste waters. Industrial inorganic drains (Cr, Ni, Cu, CN) limited very strongly the quantitative and qualitative settlement on the bottom of the Marzec stream. Organic pollution (from domestic drains, vegetal from the linen factory, and animal from the plant for fattening store animals) mainly increased the number of Oligochaeta (mostly Tubificidae) and more rarely that of the Tendipedidue. The benthos had the greatest number of species on the upper unpolluted localities of the Wislok, where indicator species for pure running waters commonly appeared. (Sjolseth and Katz-Washington)
W70-06048

CHEMICAL INTERACTIONS OF WASTE WATER IN A SOIL ENVIRONMENT,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
B. F. Hajek.
Journal Water Pollution Control Federation, Vol 41, No 10, Oct 1969. p 1775-1786, 9 fig, 20 ref.

Descriptors: *Soil environment, *Disposal, *Waste water, Adsorption, Filtration, Cation exchange, Equilibrium, Dispersion.
Identifiers: *Assimilative capacity, *Chemical interaction, *Soil waste water reactions, Soil-column technique, Equilibrium technique, Biological degradation, Dynamic column technique, Hydrodynamic dispersion, Effluent analysis.

Experimental methods for predicting the assimilative capacity of soils for chemically contaminated waste water and the important chemical interactions when contaminated waste water is disposed into the soil are discussed. Laboratory studies were made to analyze chemical characteristics of waste water, soil and their chemical interactions. In order to assess fully the assimilative capacity of the soil with regard to waste water, the following major waste water parameters should be studied: pH, pollutant form and concentration, complementary ion concentration, temperature and volume-disposal characteristics. In regard to soil, the significant parameters are: grain size distribution, bulk density, minerological characteristics, ion-exchange capacity, and resident exchangeable cations. Soil waste water interrelationships are evaluated using batch equilibrium and soil-column techniques. In addition the characterization of the soil waste water reactions, pollutant migration rates and concentration distributions can be predicted using either theoretical or emperical approaches. (Shankar-Texas)
W70-06052

HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 05D.
W70-06095

EFFECTS OF SURFACE RUNOFF AND WASTE DISCHARGE INTO THE SOUTHERN SECTOR OF KANOEHE BAY: JANUARY-APRIL 1968,
Hawaii Univ., Honolulu. Water Resources Research Center.
Edison L. Quan, Reginald H. F. Young, Nathan C. Burbank, Jr., and L. Stephen Lau.
Technical Report No. 35, January 1970. 39 p, 2 tab, 19 fig.

Descriptors: *Estuaries, Surface runoff, Domestic waste, Water pollution effects, *Sewage effluence, *Enteric bacteria, *Nitrates, *Phosphates.

A study of the surface water quality in the southeastern portion of Kanoehe Bay was undertaken between February and mid-April, 1968. The aims of this project were to determine: (1) the effect of surface runoff on water quality in the Bay, (2) the chemical and bacterial content of wastewaters emerging from two sewage treatment plant outfalls, and (3) whether the overall water quality standards were met. High rainfall and subsequent high surface runoff introduce high concentrations of nitrate-nitrogen and and fecal streptococci into the lower reaches of Keaahala and Kaneohe streams. High concentrations of fecal streptococci also occur in waters overlying a clam bed during high stream flows, suggesting that a potential public health hazard may exist during the rainy period. High land runoff lowers the water temperature by 2 degree C over dry weather flow and causes silt turbidity along the nearshore waters in the Bay. Phosphate-phosphorus concentrations in the Bay waters at the location of waste discharge averaged 0.046 mg/l for the Kanoehe sewage treatment plant and 0.033 mg/l for the Kaneohe Marine Corps Air Station sewage treatment plant, exceeding the limit established for Class A waters by 0.021 and 0.008 mg/l, respectively. Surface runoff is not a significant contributor of phosphates into the Bay compared to the sewage waste discharge. In general, the dissolved oxygen content and pH adequately met the water quality standards at all stations except for two low dissolved oxygen readings in Keaahala Stream. From mid-bay to the northern portion of the Bay, the parameters utilized indicated that the overall water quality met the standards established for both Class AA and A waters.
W70-06099

THE DELAWARE VALLEY ENVIRONMENT: STATUS AND PROSPECTS.
Greater Philadelphia Chamber of Commerce, Pa.; and University City Science Center and Inst., Philadelphia, Pa.
For primary bibliographic entry see Field 06G.
W70-06101

CONCENTRATION OF DDT BY SEDIMENTED POLLUTING OILS,
Michigan Univ., Ann Arbor. Dept. of Industrial Health.
For primary bibliographic entry see Field 05B.
W70-06122

OIL ON THE SEA.
Massachusetts Inst. of Tech., Cambridge, Mass.
For primary bibliographic entry see Field 05B.
W70-06155

THE BIOLOGICAL EFFECT OF COPPER SULPHATE TREATMENT ON LAKE ECOLOGY,
Wisconsin Committee on Water Pollution, Madison.
For primary bibliographic entry see Field 02H.
W70-06217

THE LIMNOLOGY OF CANYON FERRY RESERVOIR. IV. THE ESTIMATION OF PRIMARY PRODUCTION FROM PHYSICAL LIMNOLOGICAL DATA,
Montana State Coll., Bozeman. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 02H.
W70-06218

FACTORS CONTROLLING PRIMARY PRODUCTIVITY, ESPECIALLY WITH REGARD TO WATER REPLENISHMENT, STRATIFICATION, AND MIXING,
Biological Station, Lunz am See (Australia).
For primary bibliographic entry see Field 02H.
W70-06222

LIMNOLOGICAL ASPECTS OF RECREATIONAL LAKES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
For primary bibliographic entry see Field 02H.
W70-06225

SOME QUANTITATIVE ASPECTS OF ALGAL GROWTH IN LAKE MENDOTA,
Wisconsin Univ., Madison. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-06229

PRIMARY PRODUCTION AND WATER QUALITY IN SMITH MOUNTAIN LAKE, VIRGINIA,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-06230

THE PRODUCTION OF ORGANIC MATTER BY THE PHYTOPLANKTON IN A DANISH LAKE RECEIVING EXTRAORDINARILY GREAT AMOUNTS OF NUTRIENT SALTS,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-06233

THERMODYNAMICS OF BIOLOGICAL SYNTHESIS AND GROWTH,
Standford Univ., Calif. Dept. of Civil Engineering.
Perry L. McCarty.
International Journal of Air and Water Pollution, Vol 9, No 10, p 621-639, 1965. 4 fig, 10 tab, 40 ref.

Descriptors: *Energy transfer, *Thermodynamic behavior, *Waste treatment, Microorganisms, Water pollution control, Nutrients, Synthesis, Metabolism.
Identifiers: Biological growth, Chemosynthetic autotroph growth, Anaerobic heterotroph growth, Free energy efficiency, Adenosine phosphate, Cell energy, Aerobic heterotrophic growth, Methane bacteria.

A study is made of the predictability of nutrient requirements for disposal of sludge by the activity of chemosynthetic autotrophs and anaerobic heterotrophs. The involved energy relationships are linked to adenosine triphosphate (ATP), each mole of which has an average production potential of 10.5 grams of dry bacterial tissue. A transfer of energy from substrate to the cells of microorganisms hydrolyses ATP to diphosphate (ADP), which is returned to the food source for a 'recharge' to triphosphate. The energy obtained by the cell is best indicated by the theoretical oxygen equivalent of the organic matter (chemical oxygen demand (COD)). In turn, the growth yield (f-sub-s) is given by the quotient of cells' COD over COD of the substrate utilized. The fraction of the substrate utilized for energy is then f-sub-e = 1 - f-sub-s. On these premises, the normal efficiency of energy transfer was estimated between 40 and 70% for both au-

totrophic and heterotrophic bacteria under aerobic and anaerobic conditions. With certain exceptions, growth of microorganisms can be estimated by use of the relation between free energy of reaction, energy transfer efficiency, and energy requirements for synthesis and maintenance. (Wilde-Wisconsin)
W70-06234

THE PHOTOSYNTHETIC PIGMENTS OF LAKE SUPERIOR PERIPHYTON AND THEIR RELATION TO PRIMARY PRODUCTIVITY,
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 02K.
W70-06238

SOME EFFECTS OF THE KISSIMMEE RIVER CHANNELIZATION ON THE FISHERY RESOURCE,
Jon Buntz.
Report to Florida Game and Fish Commission May 1969. 11 p, 14 ref.

Descriptors: *Florida, *Channel morphology, *Aquatic environment, *Fish, Channels, Canals, Water conveyance, Meanders, Projects, Project planning, Channeling, Water conservation, Irrigation engineering, Drainage engineering, Environmental effects, Vegetation effects, Water pollution effects, Drainage effects, Fish migration, Fish conservation, Fish food organisms, Fish populations, Nutrients, Aquatic habitats, Flood control, Resource develpment, Water resources, Sedimentation.

This report was prepared to clarify and substantiate a previous report on the same subject. A copy of the original report is included in this article. As a result of channelization of the Kissimmee River, 99% of the productive area of the river will be destroyed. A comparison of a river and a parallel canal indicates the existence of more food fish in the river than in the canal. Channelization of a river reduces both the sizes and variety of aquatic life by destroying key productive areas. Channelization reduces a river's natural cleaning ability and results in siltation and sedimentation. However, channelization will cause a fluctuation of the water level on the reservoir marshes. Such fluctuation is desirable for fish and wildlife production. Migration of fish will be stopped by the project's control structures. If nutrients which encourage growth of aquatic vegetation in streams are removed, the water quality is improved. However, more nutrients will be available in the Kissimmee River since the filtering effect of the marsh has been reduced 92%. Pollution and vegetation will be increased. Channelization of the river will alter the fishing environment by eliminating natural protection previously afforded by the deep sheltering pools at the river bend meanders. The annual inundation of the Kissimmee River flood plain will be practically eliminated by the project plan, consequently reducing vast acreage of habitat attractive to waterfowl, fish and non-game species of wildlife. (Powell-Florida)
W70-06287

5D. Waste Treatment Processes

EFFECT OF ANTIBACTERIAL AGENTS ON MINE DRAINAGES, USE OF VIABLE ANTIBACTERIAL AGENTS TO REDUCE POLLUTION BY MINE DRAINAGES,
MSA Research Corp., Evans City, Pa.
For primary bibliographic entry see Field 05G.
W70-05959

CONTROL OF POLLUTION BY UNDERWATER STORAGE, FEASIBILITY OF PROVIDING TEMPORARY UNDERWATER STORAGE OF STORM OVERFLOW FROM A COMBINED SEWER SYSTEM.
Underwater Storage, Inc., Washington, D.C.

Available from the Clearinghouse as PB-191 217, $3.00 in paper copy, $0.65 in microfiche. Water Pollution Control Research Series, DAST-29, 161 p, 9 tab, 56 fig, 12 ref, December 1969. FWPCA Program No. 11022 DWF---12/69.

Descriptors: *Pumped storage, *Waste storage, *Wastewater treatment, Overflow, Water storage, Water pollution control.
Identifiers: *Underwater storage, Storm overflow, Combined sewers, Pumping stations.

A pilot plant was designed, constructed and operated to assess the feasibility of providing a facility for the collection, treatment, storage and final disposition of a portion of the storm overflow from a combined sewer system serving a thirty-acre drainage area in Washington, D.C. A Parshall flume was installed in the overflow line for measurement of flow rates and determination of total overflow volume. A portion of the overflow was diverted to the pilot plant through grit chambers and a comminutor. Flow was stored in two 100,000-gallon underwater bags fabricated of nylon reinforced synthetic rubber and fastened to the river bed by a system of patented anchors. During the period of storage, compressed air was delivered to the tanks for agitation of the solids. Following cessation of the storm, contents of the bags were pumped to the interceptor sewer for delivery to the District of Columbia Sewage Treatment Plant at Blue Plains. Flow into and out of each underwater storage tank was metered and recorded. Samples of the combined sewage overflow discharged to the bags and pumped discharge from the bags were collected and subjected to laboratory analyses. During the operation period from January through September, 1969, a total of 1,600,000-gallons of diverted overflow from 38-storms was stored in the tanks. In addition, 600,000-gallons of river water was pumped into the underwater storage tanks for testing during dry weather periods. The total amount stored was pumped to the interceptor sewer in 26-separate pump out periods. The cost of the pilot plant was $341,480.00, or $1.70 per gallon of storage. This included facilities for testing, samples and flow measurement. Estimates for larger installations, without these special requirements range from 28.2 cents to 14.6 cents per gallon for plants with storage from two to twenty million gallons. The project demonstrated that temporary storage of overflow from combined sewers in underwater rubber storage tanks is feasible and may, under suitable conditions, be effective in eliminating direct, untreated discharge of combined sewage into surface waters during storm periods. Drainage area to be served, land use, nature of storm events, and other factors must be considered when planning an underwater storage facility.
W70-06029

DEVELOPMENT OF TERTIARY TREATMENT METHODS FOR WASTE WATER RENOVATION,
Texas Univ., Austin.
W. W. Eckenfelder, Jr.
Water Pollution Control, Vol 68, No 5, p 584-591, Sept-Oct, 1969. 3 fig, 4 tab, 26 ref.

Descriptors: *Tertiary treatment, *Costs, *Phosphorus, *Nitrogen, Adsorption, Filtration, Electrodialysis, Ion exchange, Reverse osmosis, *Waste water treatment, Filtration, Chemical oxygen demand, Operating costs, *Reviews.

A review of various tertiary treatment methods available to remove pollutants not ordinarily removed by conventional treatment processes is presented. Filtration removes suspended solids to less than 3 mg/l. Soluble COD has been reduced to 7 mg/l using adsorption on activated carbon. Removal of dissolved organics may be achieved by ion exchange, electrodialysis, and reverse osmosis. Nutrients are treated separately. Phosphorus removals are possible by precipitation in primary systems, (80-90%), precipitation in aeration tanks, (50-92%), post-precipitation (90%) and luxury biological uptake (85-90%). Stripping, ion-exchange and nitrification followed by denitrification are described for nitrogen removal. Data on all the unit processes mentioned are given as are cost figures for: adsorption, ion exchange, nitrification and denitrification, chemical treatment, stripping, separation beds, carbon adsorption and electrodialysis. Operating costs for a 10 mgd plant utilizing primary clarification, activated sludge, phosphorous precipitation, nitrification-denitrification, filtration, and carbon adsorption is estimated to be 15 cents/1000 gallons. (DiFilippo-Texas)
W70-06049

FILTRATION OF TREATED SEWAGE EFFLUENT,
Stanford Univ., Calif.
George Tchobanoglous, and Rolf Eliassen.
Journal Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA 2, p 243-265, April 1970. 17 fig, 4 tab, 27 ref. FWPCA Grant WPD 21-05.

Descriptors: *Filtration, *Equations, *Tertiary treatment, Filters, *Waste water treatment, Particle size, Zeta potential.
Identifiers: Straining.

Filtration studies were conducted on pilot scale activated sludge treatment plant effluent which was characterized by suspended solids, particle size, particle distribution, particle change and change distribution. Straining was found to be the principal mechanism responsible for the removal of particulate matter. Filter performance equations were developed for the conditions studied and were based on the size and distribution of particles, their floc strength, the size of the filter medium, the filtration rate and the amount of material arrested within the filter. These equations can also be generalized for cases where straining is not the principal removal mechanism. (Sorber-Texas)
W70-06050

AUTOMATED VARIABLE FLOW FOR PILOT PLANTS,
Minnesota Univ., Minneapolis.
Walter K. Johnson.
Environmental Science and Technology, Vol 4, No. 1, p 68-69, January 1970. 2 fig, 1 tab. FWPCA Project WP-01028.

Descriptors: *Pilot plants, *Automatic control, *Flow, Model studies, *Waste water treatment.
Identifiers: Sigma motor, Variable flow, Variable waste strength.

A new device has been developed which permits pilot plants to vary the rate of input flow continuously and automatically. A disk is used to produce a sinusoidal flow pattern. This is accomplished by pinning one end of a lever arm to the rotating disk and the other end to the zero-max speed controller. With the equipment studied (Sigmamotor) flow rates were varied between 13 ml/min and 3800 ml/min. (Hancuff-Texas)
W70-06051

GROWTH OF CHLORELLA PYRENOIDOSA 71105 IN ACTIVATED SLUDGE WASTE EFFLUENT,
General Dynamics Corp., Groton, Conn. Electric Boat Div.
Donald E. Leone.
Journal Water Pollution Control Federation, Vol 41, No 1, p 51-55, Jan 1969. 5 tab, 9 ref.

Descriptors: *Algae, *Activated sludge, *Effluents, Waste water reclamation, Waste water treatment, *Nutrients.
Identifiers: Mass culture of algae, Packed cell volume.

Processed waste effluent was studied, using Chlorella pyrenoidosa 71105, as a method for algae growth and possibly waste water reclamation. Treated waste effluent, centrifuged and filtered twice through charcoal for removal of color, was supplemented with iron and/or urea and compared with DL-61 and EB standard algae media. While preliminary data revealed deficient magnesium, phosphorus, and sulfates and sufficient calcium, nitrogen, and iron for normal algal nutrients; supplementing waste effluent with iron was beneficial. Data revealed that effluent alone and effluent supplemented with urea showed a substantial lowering of doubling time and reduced PCV (packed cell volume). The waste effluent containing additional iron and urea showed higher chlorophyll content, although fewer cells were produced, when compared with effluent supplemented with iron and diluted standard media. Results indicated that processed waste effluent supplemented with iron (0.56 mg/l total) was a good medium for Chlorella pyrenoidosa 71105 and produced as much PCV as the diluted standard media. (Morgan-Texas)
W70-06053

PERFORMANCE CHARACTERISTICS OF AN OXIDATION DITCH,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
T. J. Casey, and J. P. Clerkin.
Water Pollution Control, Vol 68, No 6, p 687-695, Nov-Dec, 1969. 7 fig, 4 tab, 22 ref.

Descriptors: *Domestic wastes, *Treatment facilities, *Waste water treatment, *Biochemical oxygen demand, Dissolved oxygen, Effluents, Performance, Operational, Design data, Oxidation, Settling basins, Chemical oxygen demand.
Identifiers: *Oxidation ditch, Suspended solids, Extended aeration, Dublin (Ireland).

Analysis of the performance of an oxidation ditch for an equivalent population of 750 persons was made. A design loading of 1 lb BOD/d per 88 cu ft of ditch volume yielded a capacity of 7920 cu ft. An aeration rotor designed to yield 180 lb O2/d was utilized. The oxygenation capacity of the rotor at various emmersion depths was calculated and plotted. The response of the system to changes in rate of flow was quite rapid. There was no inflow to the plant for a 2-3 hour period each week day since a pharmaceutical waste was diverted. Plant performance evaluated under conditions of both overload and underload, 152 percent and 59 percent of design loading. BOD, COD, suspended solids, NH (+) (as N4), NH3 (as N) and pH of the influent and effluent were measured. Dissolved oxygen levels recorded continuously. BOD removal averaged 94.9 and 95.2 for the overloaded and underloaded conditions. Nitrification took place during both test series while some denitrification took place during the overloaded test series. The yield of excess sludge was within 20-30 g/inhabitant equivalent. Volatile content of the excess sludge varied between 67.5 and 72.0 percent. Peak oxygen demand for domestic sewage is 3 to 4 times the average BOD loading. Oxygenation capacity usually adapted in design is twice the average BOD loading, thus oxygen deficiency of limited duration may be experienced. (Galwardi-Texas)
W70-06054

FARM WASTES,
Netherlands Government Agricultural Waste Water Inst., Arnhem.
H. M. J. Scheltinga.
Water Pollution Control, Vol 68, No 4, p 403-413, July-August, 1969. 3 fig, 2 tab, 5 ref.

Descriptors: *Farm wastes, *Activated sludge, *Aerobic treatment, Water pollution, Extended aeration, Fertilizers, Biochemical oxygen demand.
Identifiers: *Oxidation ditch.

Manure in modern automated animal houses is often collected by falling through slatted floors into a channel. The final waste is a slurry and has little value. Volume, dry matter, BOD, and total N values are listed for man, cow, calf, sheep, pig, and hen wastes. Anaerobic manure storage results in 50% BOD reduction. The usual disposal method is using a fertilizer, but there must be a demand within a reasonable distance. Volume reduction methods are: treat the slurry liquid portion separately; or dewater the slurry mechanically or thermally. Treatment by oxidation ditch is discussed. Average effluent figures, in mg/l, are: COD, 100-1000; BOD, 10-100; NH3, 5-50; NO2, 0-50; NO3, 10-200; pH, 6.5-8.5. Oxygen concentration is important; and OC: load ratio of 2 is suggested for design. There was a 40-50% NH3 and total N reduction when air was bubbled thru a pig waste, but no reduction occurred in a similar waste which has been poisoned with C (++). It was concluded that mechanical ammonia stripping does not eliminate nitrogen compounds. Oxidation ditch construction is discussed. Costs of alternative disposal methods such as transportation to farm land or artificial drying must be considered when deciding which to use on oxidation ditch. (Steiner-Texas)
W70-06056

WATER POLLUTION CONTROL IN THE BURGH OF MOTERWELL AND WISHAW,
D. H. Barraclough.
Water Pollution Control, Vol 68, No. 1, p 102-117, Jan-Feb, 1969. 14 fig, 1 tab, append.

Descriptors: *Waste water treatment, *Activated sludge, *Operation and maintainence, Sewerage, Costs, Industrial wastes, Storm runoff, Effluents, Sludge treatment.
Identifiers: *Carbarns Works (England), *Clyde Park Works (England), *Coursington Works (England), *Combined sewers, Raw sewage.

General discriptions are given for unit operations at three sewage works: Carbarus, Clyde Park and Coursington. At the 3.0 MGD Carbarns Works excessive storm water flows created problems in operation. Sludge did not settle readily due to the excessive flows and organic matter lost through storm overflows combined with suspected toxic substances created digestion problems. Activated sludge averaged 73.4% BOD reduction with an air supply of 1.0 cu ft/gal. of sewage treated. Climatic conditions caused problems in sludge drying and it was found that drying beds 'topped' with ashes gave best results. The 30:20 standard was met at the 1.75 MGD Clyde Park Works with an air consumption of 0.6 cu ft/gal. Average BOD reductions were 83.2% in 1966. Sludge from the 0.9 MGD Coursington Works is stored before disposal at sea or tanked to the Clyde Park Works for digestion. (Berryhill-Texas)
W70-06057

BIODEGRADATION OF LINEAR ALKALATED SULFONATES.
New York Univ., Bronx.

Environmental Science and Technology, Vol 2, No 10, p 773-778, Oct 1969. 6 tab, 2 fig, 30 ref.

Descriptors: *Linear Alkylate Sulfonates, *Biodegradation, *Alkylbenzene sulfonates, *Detergents, Sulfur compounds, Degradation, Organic compounds.

Primary alkylbenzenesulfonates (PABS) and linear alkylbenzenesulfonates (LAS) are degraded biologically by the organism Pseudomonad via one of two oxygen demanding pathways, via benzeoic or phenlacetic acid. Degradation of PABS with an odd number of carbon atoms and LAS with an even number of carbon atoms proceeds via benzeoic acid. Degradation of PABS with an even number of carbon atoms proceeds via phenylacetic acid, and degradation of LAS with an odd number of carbon atoms proceeds by both pathways. (Hancuff-Texas)
W70-06058

THEORETICAL STUDY OF HIGH-RATE SEDIMENTATION,
Camp, Dresser and McKee, Boston, Mass.
K. M. Yao.
Journal Water Pollution Control Federation, Vol 96, No 2, part 1, p 218-228, February 1970. 8 fig, 7 ref.

Descriptors: *Sedimentation, Design, Length, *Mathematical studies, Tubes, Uniform flow.
Identifiers: *High-rate sedimentation, Angle of inclination, Overflow rate, Parallel plates, Shallow tray.

A mathematical analysis is made for shallow tray, uniform flow, parallel plate, and circular tube high-rate settlers. The performance of high-rate settling system can be characterized by a parameter S which is a function of fall velocity of a suspended particle, the average velocity of flow through the settler, the relative settler length (ratio of length to depth), and the angle of inclination of the settler. A critical S calue, Sc, can be defined. All particles with S greater than Sc are removed in the settler while the fractional removal of particles with smaller S values can be expressed as a function of S. An equation is developed to use overflow rate as a basis for designing a high-rate system. Analysis of the effects of relative length and angle of inclination on settler performance showed that performance increases sharply up to a relative length equal to 20 and performance decreases sharply as the angle of inclination exceeds 20 degrees. A discussion of design considerations and numerical examples are presented. (DiFilippo-Texas)
W70-06059

TERTIARY FLOCCULATION AND FILTRATION,
Dayton, Ohio.
DeFro Tossey, Paul J. Fleming, and Ronald F. Scott.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA1, p 75-90 Feb., 1970. 2 fig, 13 tab.

Descriptors: *Flocculation, *Tertiary treatment, *Filtration, Efficiencies, Biochemical oxygen demand, Nutrients, Phosphate, Sedimentation, Costs, Waste water treatment.

The conventional water treatment processes of flocculation, sedimentation, and filtration were studied in a 0.5 mgd pilot plant to demonstrate their applicability in tertiary treatment of trickling filter effluent. It was demonstrated that significant effluent quality improvements can be made employing these processes. Lime and alum were used as primary coagulants and activated silica, ferric sulfate and an organic polyelectrolyte were used as coagulant aids. Optimized treatment schemes and chemical dosages produced effluents containing 4 mg/l BOD5, 25 mg/l suspended solids, and 5 mg/l phosphate. Capital and operating cost estimates for a full-scale plant treating 75 mgd of trickling filter effluent ranged from 37 cents/1000 gallons to 43 cents/1000 gallons depending upon the chemicals employed. (Sorber-Texas)
W70-06060

THE COST OF SEWAGE TREATMENT,
Newcastle-upon-Tyne Univ. (England).
Rm. M. Bradley, and Peter C. G. Issac.
Water Pollution Control, Vol 68, No. 4, p 368-402, July-August, 1969. 37 fig, 14 tab, 20 ref.

Descriptors: *Cost analysis, Municipal wastes, *Capital costs, *Operating costs, *Waste water treatment, *Sewage treatment.
Identifiers: United Kingdom.

A brief survey of capital and operating costs of municipal sewage treatment in the United Kingdom was prepared with data obtained from 12 consulting engineering firms and 34 treatment works. Difficulty was experienced in obtaining complete data, particularly in operating costs. The capital costs survey was based on 79 works; 40% served popula-

tions less than 5000 and 80% served populations in the 10000 to 50,000 range. Graphs were produced by a computer program using the least squares method to present capital cost data of totalworks, components, and associated costs as functions of population and/or capacity. The operating cost data was obtained from 34 treatment works serving populations from 100 to greater than 100,000; 54% served populations less than 10,000 and 91% served populations less than 50,000. Annual operating costs, excluding debt costs and with these costs included, are graphically presented for the most extensively used process, single filtration, as a function of population served. A relationship between annual operating costs and total capital costs as a function of debt charges, was determined and presented graphically. The average annual operating cost was approximately 3.1% of total capital cost. The debt charges represent approximately 69% of total annual operating cost. The main conclusion drawn from the survey was that data available are inadequate. (Morgan-Texas)
W70-06061

A SURVEY OF SOME SEWAGE TREATMENT AND ALLIED PROBLEMS AT NORWICH, 1963-1968,
Norwich Sewage Treatment Works (England).
P. Cotton.
Water Pollution Control, Vol 68, No 6, p 627-634, Nov-Dec, 1969. 3 tab, 25 ref.

Descriptors: *Activated sludge, *Sludge treatment, Sludge digestion, Sphaeratilus, *Sewage treatment, *Waste water treatment.
Identifiers: Trade effluent control, Filter pressing.

The city of Norwich sewage treatment works, built in 1963 with a design capacity of 7.5 mgd treated a flow of 9 mgd which has created several problems. Raw sludge pumped to the digestion plant created high peak rates of gas production causing reduced efficiency. In 1965 the screw pumps and pipework was modified to increase the gas storage space above the sludge and the surface area of the sludge, solving the problem. Due to extension designs, experimental treatments of sewage in a small-scale diffused air activated sludge plant were performed. Results were excellent and growths of Sphaerotilus were controlled by baffles fitted inside the aeration tank. Other experiments were done on filter presses using coagulants, copperas and lime, aluminum chlorohydrate and polyelectrolytes. Mixtures of primary, humus and activated sludges using copperas and lime gave reasonably dry cakes. The cost of the extensions designed were paid through trade effluent control and charges beginning mid-1966. (Waid-Texas)
W70-06062

FLOCCULATION OF NEGATIVELY CHARGED COLLOIDS BY INORGANIC CATIONS AND ANIONIC POLYELECTROLYTES,
Dow Chemical Co., Midland, Mich.
Arthur S. Teote, and Stacy L. Daniels.
Environmental Science and Technology, Vol 3, No 9, p 825-829, Sept 1969. 5 fig, 2 tab, 16 ref.

Descriptors: *Colloids, *Flocculation, *Sewage treatment, Waste water treatment.
Identifiers: *Polyelectrolytes.

The rates and degrees of flocculation of a monodispersed synthetic latex and a polydispersed raw sewage were determined optically after each system had been treated sequentially with inorganic cations and anionics polyelectrolytes. These anionic colloids are not flocculated significantly by anionic polyelectrolytes in the absence of multivalent cations. It was discovered that raw sewage colloids could be flocculated by anionic polyelectrolytes provided the metal cations were present. Multivalent cations work best in flocculation. Divalent cations which are naturally present in these colloids primarily govern the flocculation. Rates and degrees of flocculation of raw sewage were logarithmic functions of polyelectrolyte and multivalent cation concentrations. (Hancuff-Texas)
W70-06063

OCEAN OUTFALLS MAINTENANCE AND REPAIR,
Los Angeles County Sanitation District, Calif.
Robert M. Powell, and Robert E. VanHeuit.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1900-1904, Nov 1968. 2 ref.

Descriptors: *Outfalls, *Ocean, *Inspection, *Maintenance, Waste water, Corrosion, Marine plants.
Identifiers: *Los Angeles, Diffuser, Ballast.

The County Sanitation Districts of Los Angeles County own a complex system of trunk sewers, treatment plants, and ocean outfalls serving an area of approximately 700 square miles with an estimated population of 3,400,000 people. Discussed are the maintenance and repair problems of the districts four outfalls varying in size from 60" to 120" in diameter handling up to 450 mgd. Items to be maintained and methods thereof are included. Some examples of the problems are: (1) a buildup of grease, grit and gravel within the diffuser section, which was solved through bulkhead removal and flushing and (2) corrosion of joints which was minimized through anotic protection although material substitution is said to be better. Solution of specific area outfall problems also is covered. Conclusions indicate that periodic inspection and surveillence are the key to proper maintenance. (Hancuff-Texas)
W70-06065

THE OZONATION OF PHENOLIC WASTES,
Department of National Health and Welfare, Ottawa (Ontario).
Hugh R. Eisenhauer.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1877-1899, Nov 1968. 7 fig, 2 tab, 13 ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Ozone, *Phenols, Mathematical models, Treatment.
Identifiers: Catechol, Concentration, Ozonation, Ultraviolet analysis.

This research describes the effect of ozone on phenolic wastes. Ozone from a commercial ozonator was introduced into a glass reactor at room temperature with a porous glass dispersion tube and samples were withdrawn for phenol and catechol analysis. Catechol is the first oxidation product of phenol. The rate of phenol degradation was directly proportional to the phenol concentration, the ozone concentration in the gas feed, and the gas flow rate, and inversely proportional to gas bubble diameter. The kinetics of catechol degradation were similar. After an initial uptake of about 4 moles of ozone per mole of phenol the phenol and catechol had disappeared, however, degradation products continued to consume ozone at a slower rate and a constant efficiency of 50%. A reaction mechanism was proposed in the form of a mathematical model. (Hancuff-Texas)
W70-06066

ACTIVATED SLUDGE BASIC DESIGN CONCEPTS,
Kansas Univ., Lawrence.
Ross E. McKinney, and Walter J. Oferien.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1831-1843, Nov. 1968. 16 ref.

Descriptors: *Activated sludge, *Aeration, *Design, *Waste water treatment, History, Mixing, Settling basins, Sludge disposal.
Identifiers: Screening, Primary sedimentation, Secondary sedimentation.

The design of activated sludge systems has evolved slowly and progess has been made largely on an empirical basis. This paper presents the basic design concepts for a modern activated sludge system including the foundations on which these concepts were developed. Design parameters developed for conventional and completely mixed systems indicate that aeration will be from 3 to 8 hours. Total MLSS will range from 1500 to 4000 mg/l, organic loads of 0.5 to 0.7 lb BOD/lb microbial solids will yield good operations, and diffused aeration of 1000 cubic feet of air per pound of BOD removed is a sound parameter. All aspects of activated sludge schemes are discussed with design parameters given. (Hancuff-Texas)
W70-06067

ECONOMIC EVALUATION OF AERATOR SYSTEMS,
Eimco Corp., Salt Lake City, Utah.
A. A. Kalinske.
Environmental Science and Technology, Vol 3, No 3, p 229-234, March 1969. 8 ref.

Descriptors: *Aeration, *Equipment, Performance, Economics.
Identifiers: *Diffused air, *Turbin dispersers, *Surface aerators.

Sound design principles and test procedures are set down for the selection of aerator systems. Basic design guidelines are given as well as methods of economic and technical evaluation which may aid engineers in designing aerobic biological treatment plants. The three principal oxygenation methods presented are: diffused air, turbin dispersion, and surface aeration. Equations are presented which may be utilized in the calculation of required horsepower for each aeration system. Sample calculations are given with the following results: diffused air--1.85 lbs O2/HP-hr, turbin disperser--2.5 lbs O2/HP-hr, and surface aerator--2.8 to 4.5 lbs O2/HP-hr. A discussion on evaluation of aerator performance is given denoting some of the common pitfall. (Hancuff-Texas)
W70-06068

DITCHES PROVIDE EFFICIENT TREATMENT,
West Virginia Univ., Morgantown.
Jerry C. Burchinal, and Charles R. Jenkins.
Environmental Science and Technology, Vol 3, No 11, p1170-1173, November 1969. 3 fig, 5 ref.

Descriptors: *Ditches, *Efficiencies, *Design, Sewage treatment, Capital cost, Operating cost, *Waste water treatment.
Identifiers: *Oxidation ditch, *Cameron (W Va), Velocity profile.

An evaluation of an oxidation ditch at Cameron, W. Va. is presented. The plant was designed for a population of 2400 and flow of 240,000 gpd. The ditch is 620 feet long, 4 feet deep, 16 feet top width and 9 feet bottom width. Two 8 ft 27 1/2 in diameter rotors operate at 75 rpm and 6 in submergence. The average retention time is 24 hours and flow velocity is kept at 1 fps. Data collected from September 1965 - August 1967 showed flow variations between 69,400 - 438,000 gpd. The latter being influenced by combined storm water flow. At low flows efficiencies were: BOD 86-98%, SS 49-97%, ABS 74%. Maximum monthly average SS in ditch were 9941 which corresponded with highest efficiencies. D.O. variations within the ditch was between 5.2 and 9.0. Capital cost for an oxidation ditch is given as $29 - $68/1000 population with an average of $45. (National Cost Index - April 1966) construction costs are $0.35/gpd for population of 5000 and $0.83/gpd for 250. Annual unit operating costs are given as $104.50/1,000,000 gallons. (Hancuff-Texas)
W70-06069

WASTE DISPOSAL FROM WATERCRAFT,
Cargo Carriers, Inc., Minneapolis, Minn.
Robert H. Hertzberg.
Journal Water Pollution Control Federation, Vol 40, No 12, p 2055-2058, Dec 1968.

Descriptors: *Pollution abatement, *Legislation, *Waste water treatment, BOD, Standards, Water Quality Act, Waste treatment, Nutrients.
Identifiers: *Watercraft, Devices, Coliform count.

The American Waterways Operators, Inc., a trade association representing water carriers of all types operating on the U. S. Inland Waterways feels that the establishment of standards for waste water discharge is a job of the federal government. In 1967 the individual states had watercraft laws which controlled watercraft discharge in varying degrees and which would create confusion if enforced as interstate measures. The Federal legislative background to date includes provisions in the Water Quality Act for state control and new bill HR 13923 (not yet passed) which puts pollution control of navitigable waters in federal hands. Four types of control devices are discussed: (1) a holding tank which holds the waste until it can be transferred to a shoreline treatment facility, (2) a macerator which grinds and mixes the wastes with a chemical, usually chlorine, holds the waste for a period, then discharges, (3) incinerator which reduces the human waste to ash, and (4) self-contained recirculating device which removes the solids and purifies the liquid for reuse. (Hancuff-Texas)
W70-06070

MECHANICAL DEWATERING OF MIXED SLUDGES AT ANDOVER,
D. Hamilton.
Water Pollution Control, Vol 68, No 2, p 221-227, March-April, 1969. 3 tab, 2 ref.

Descriptors: *Sludge disposal, Biochemical oxygen demand, *Filteration, *Waste water treatment.
Identifiers: Andover (England), *Filtrate, Rotoplug sludge concentrator, Permanganate value.

The City of Andover, England operates a 1.35 million gal/day trickling filter plant. To facilitate sludge disposal a Rotoplug sludge concentrator was installed. This relieved the load on the cold digestion plant. The concentrator, which handles mixed raw primary and humus sludge, has 12 cells fitted with a nylon cloth 1.5 ft by 10.5 ft. The concentrator was expected to handle 18 pounds dry solids/cell per hour but over a two year period this figure ranged from 18.8 to 57.8 pounds dry solids/cell per hour. Over the same period efficiency of solids capture ranged from 33.6 percent to 83.4 percent. The filtrate, which is settled for one hour with the supernatant being sent to the sedimentation tanks and sludge to the digestion plant had BOD values in the range of 18,000 to 22,880 mg/l, permanganate values in the range of 2400 to 4720 mg/l and dry solid contents from 2.26 percent to 4.00 percent. After one hour of settling the values were 3400 to 4140 mg/l, 435 to 576 mg/l and .22 to .44 percent respectively. The cloths lasted 26 months. (DiFilippo-Texas)
W70-06071

THE INDUSTRIAL WASTES CONTROL PROGRAM IN NEW YORK CITY,
Department of Water Resources, New York. Bureau of Water Pollution Control.
For primary bibliographic entry see Field 05G.
W70-06072

MEMBRANE PROCESSES GAIN FAVOR FOR WATER REUSE,
Water Pollution Research and Applications Inc., Washington, D.C.
Jacob I. Bregman.
Environmental Science and Technology, Vol 4, No 4, April 1970, p 296-302. 4 tab.

Descriptors: *Tertiary treatment, *Reversed osmosis, *Electrodialysis, *Membrane processes, *Water reuse, Industrial waste treatment, Costs, Waste water treatment.

The results of studies with both reverse osmosis and electrodialysis has shown that it is technically feasible to convert sewage effluent to potable quality. The cost associated with treating secondary effluent by reverse osmosis is 22.4 cents/1000 gal. A comparable treatment through electrodialysis would cost 20.7 cents/1000 gal. The results from several reverse osmosis test facilities are presented. Typical results are 90-95% rejection of all species except nitrogen with complete removal of ABS, odor and turbidity. Several tables present the results of reverse osmosis treatment on such wastes as paper mill, brackish water, irrigation return, acid mine drainage, agricultural wastewater, and municipal wastes. Several of the associated problems are also listed, e.g. organic fowling of cellulose acetate membranes. (Hancuff-Texas)
W70-06073

COLLOIDS COMPLICATE TREATMENT PROCESSES,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
Robert B. Dean.
Environmental Science and Technology, Vol 3, No 9, p 820-824, Sept 1969. 8 ref.

Descriptors: *Colloids, *Biological properties, Sewage treatment, Electrodialysis, Filtration, Activated carbon, Waste water treatment.
Identifiers: *Hydrocolloids.

Most of the colloidal material which remains in effluence from biological treatment plants is derived from the microbial organisms that bring about the treatment. A discussion is presented on the various types of flocculating material created by biological treatment. Although most of a polymetric flocculant should be absorbed at the optimum flocculant dose, activated sludge probably contains an excess of polymer that contributes to its poor dewatering properties. It is characteristic of polymer flocculants that they act as a dispersant when present in an excess over the optimum dose. Some of the colloid problems associated with advanced treatment processes are presented. Examples are rapid clogging of filters, the frequent backwash of activated carbon columns, and accumulation of colloids on electrodialysis units resulting in a reduction of salt flux. (Hancuff-Texas)
W70-06074

DETERMINATION OF EMULSIFYING OIL IN INDUSTRIAL WASTE WATER,
Detroit Metropolitan Water Service, Mich.
Michael J. Taras, and Karl A. Blum.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 2, p R404-R411, Nov. 1968, 4 tab, 4 ref.

Descriptors: *Chemical analysis, *Industrial wastes, *Oil, Salt, Waste water treatment.
Identifiers: *Emulsified oil, *Quantitative analysis, Determination, Recovery, Sodium chloride.

Scope of the current standard method for determination of grease can be extended to include emulsifying oils present in industrial waste water by saturating the acidified sample with sodium chloride before isolating the oils on the filter in the standard manner. This modification improved oil recoverys in every case over the wide variety of emulsifying oils tested. Even the most difficult sample was about 85% recoverable by this method. Comparative experiments with trichlorotrifluoroethane, and n-hexane as extracting solvents yielded similar results for the grease and oil samples. Trichlorotrifluoroethane was selected as the preferred solvent because of its nonflammability and higher specific gravity. (Hancuff-Texas)
W70-06075

UNDERGROUND DISPOSAL OF ACTIVATED SLUDGE,
Dow Chemical Co., Midland, Mich.
For primary bibliographic entry see Field 05E.
W70-06077

DEEDS AND DATA,
James E. Bailey, Arthur D. Caster, E. E. Ross, R. E. Hutson, and B. L. Loffell.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, 1953-1957, Nov 1968. 1 fig, 1 tab.

Descriptors: *Sewage treatment, *Data collection, Operations.
Identifiers: *Primary treatment, Arlington County (Va), Cincinnati (Ohio), Johannesburg (S Africa), Kenosha (Wis), Lewiston (Idaho), Middlesex County (NJ), Oakland (Calif), Plainesville (Ohio), Rockyhill (Conn), Vancouver (Canada).

Operating data from 10 primary treatment plants are presented. The plants examined had average BOD and suspended solids reductions of 36 and 58%, respectively, with average incoming wastewater parameters of 216 mg/l BOD5 and 197 mg/l suspended solids. Grit removal varied from 0.18 to 1.60 cu. ft./1,000,000 gal. The data presented gives average, maximum and minimum daily flow, daily flow per capita, sewage temperature, sewage strength in terms of BOD and suspended solids both influent and effluent, and efficiency of treatment. In addition data is given on grit removed, surface overflow rate in the primary sedimentation tanks, sludge volume, dry solids, and percent solids. Disinfection and effectiveness are also presented. Complete data on digester operation is included. Some process problems and costs are discussed. (Hancuff-Texas)
W70-06078

AEROBIC DEGRADATION OF LONG CHAIN FATTY ACID SALTS,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr, and Joseph C. Roth.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 2, p R385-R403, November 1968. 10 fig, 2 tab, 22 ref.

Descriptors: *Anaerobic treatment, *Salts, *Metabolism, *Waste water treatment.
Identifiers: *Fatty acids, *Warburg, *Oxygen uptake, Acclamation, Grease, Long Chain Carbon.

Warburg studies were performed on calcium and sodium long chain fatty acids. Factors investigated included fatty acids from 8 to 20 carbon atoms, degrees unsaturation type of salt, concentration, and acclamation. Fatty acids studied were acetic, caprylic, lauric, palmetic, stearic, arachidic, oleic, linoleic, linolenic, petroselenic, elaidic and palmitoleic. The study showed the sodium salts of fatty acids with 18 or less carbon atoms can be metabolized in an aerobic system. Calcium salts of the same fatty acids also can be degraded, especially if they are finally pulverized. The rate of metabolism of the fatty acid salts decreases as the chain length of the compound increases. Acclamation of the organisms to saturated fatty acids with 16 or 18 carbon atoms increase the ease with which the compounds were degraded. (Hancuff-Texas)
W70-06079

COMPUTER ANALYSIS OF ENGINEERING ECONOMIC STUDIES,
Clinton Bogert Associates, Fort Lee, N.J.
For primary bibliographic entry see Field 06C.
W70-06080

OPERATING EXPERIENCES AT SWINDON, 1962-67,
Swindon (England).
W. F. Carmichael.
Water Pollution Control, Vol 68, No 4, p 458-464, July-August 1969. 9 tab, 6 ref.

Descriptors: *Sewage treatment, *Trickling filters, *Sludge disposal, Biochemical oxygen demand, Sludge digestion.
Identifiers: *Operation, *Storm sewage, *Swindon, England, Suspended solids.

The sewage treatment works at Swindon, England, serves a drainage population of 120,300. Trade effluents constitute 6.5% of the sewage flow. From 1962 to 1967 ranges of influent BOD, suspended solids, and ammoniacal nitrogen were 272-410 mg/l, 397-534 mg/l and 40-49 mg/l respectively. Sewage treatment involves screens, grit removal, storm sewage treatment, primary settling, biological filters, and sludge treatment. Storm overflows are discharged into a 2 million gallon tank and effluent from this tank overflows on to 11 acres of under-drained land. Sludge is digested in heated tanks and digested sludge is disposed on sand drying beds, by irrigation of farm lands, and in earth banked drying beds. Gas from the digesters is used in power generation. Data on the performance and operation of all the processes employed are given. (DiFilippo-Texas)
W70-06081

THE EFFECT OF SYNTHETIC DETERGENTS ON SLUDGE DIGESTION AT RONDEBULT SEWAGE TREATMENT WORKS,
Rondebult Sewage Treatment Works, Germiston (South Africa).
P. H. v. d. Merwe.
Water Pollution Control, Vol 68, No 6, p669-672, Nov-Dec, 1969. 1 fig, 2 tab, 1 ref.

Descriptors: *Anaerobic digestion, *Detergents, *Sewage treatment, *Laboratory tests, *Neutralization, Facilities, *Waste water treatment.
Identifiers: Germiston (South Africa), *Amine residue, Synthetic, Mesophilic, Thermophilic.

The decline in gas production from sludge digestion at the Rondebult sewage treatment works has been noticeable in the last three years. A laboratory investigation revealed that the presence of relatively high concentration of synthetic detergents in the sludge was the main contributory factor. Synthetic detergent concentrations as high as 2.7 percent of dry solids were measured in the raw sludge. Laboratory-scale digesters were used for investigating the neutralization of the detergents by a residue of an industrial amine distillation process. The composition of the residue is not known, except that it contains long-chain di-alkyl amine in the ratio of two primary to one secondary amine. Studies utilizing both mesophilic and thermophilic digestion were conducted. The concentration of detergent in the mesophilic digester decreased from 3.9 to 1.3 percent of dry solids with an addition of 2.0 gm of residue/gm detergent. Although the thermophilic study was not concluded, it appears that thermophilic digestion offers no solution to the problems encountered in sludge digestion due to high concentrations of detergents. (Galwardi-Texas)
W70-06082

THE RECLAMATION OF POTABLE WATER FROM SEWAGE,
National Inst. for Water Research, Pretoria (South Africa).
G. J. Stander, and L. R. Van Vuuren.
Water Pollution Control, 1969, Vol 68, No 5, p 513-522, Sept-Oct 1969. 11 fig, 1 tab, 8 ref.

Descriptors: *Tertiary treatment, *Absorption, *Costs, *Potable water, Waste water treatment, Biochemical oxygen demand, Ammonia, Filtration, Nutrients, Chemical oxygen demand, Coliforms, Viruses.
Identifiers: *Floation, Chemical stabilization, Foam fractionation.

A pilot plant (1000 gal/hr) for the reclamation of potable water was operated using primary and secondary sewage treatment plant effluents. Pilot plant processes included flotation, ammonia stripping, chemical stabilization, and filtration, foam fractionation, chlorination and carbon adsorption. Primary clarifier and humus tank (secondary clarifier following trickling filters) effluents were separately applied as pilot plant influents. Various water quality parameters including ammonia, organic nitrogen, total nitrogen, phosphate, alkyl benzene sulphonate (ABS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), Esch. coli, and Polio I virus were followed through the system and process removal curves are provided for each parameter. Results indicated the pilot plant effluent chemical and biological quality to be well within WHO ranges for potable water. Humus tank effluent, however, resulted in a water consistantly high in nitrate-nitrogen. Costs were projected for a 1 mgd plant and amounted to 21.5 cents/1000 gal and 27.0 cents/1000 gal for treatment of humus tank effluent and primary clarified effluent, respectively. (Sorber-Texas)
W70-06083

PHOSPHATE RELEASE IN ACTIVATED SLUDGE PROCESS,
Virginia Polytechnic Inst., Blacksburg, Va.
Clifford W. Randal, Duane W. Marshall, and Paul H. King.
Journal of Sanitary Engineering Division, Proceedings of ASCE, Vol 96, No SA2, Proc. paper 7223, p 395-408, April 1970. 7 fig, 4 tab, 28 ref.

Descriptors: *Phosphorus, *Activated sludge, *Anaerobic conditions, *Oxidation-reduction potential.
Identifiers: Phosphorus uptake, Phosphorus release.

The mechanisms of soluble phosphate uptake and release by activated sludge are the subject of considerable controversy. This laboratory experiment, utilizing batch tests with a volume of 3.5 land approximately 2000 mg/l solids concentrations, found an uptake of phosphorus greater than the carbon to phosphorus ratio of 100:1 generally accepted for activated sludge: averaging more than twice this ratio. The extent of uptake varied directly with initial phosphate concentration which was between 56 mg PO4/1. Approximately 7 hours were required for stabilization of the initial 350 mg/l COD to a residual of approximately 90 mg/l COD. After stabilization of the COD soluble phosphate was released back into solution and varied between 9% and 21% of total uptake over a 4 hour period. Under controlled anoxic conditions, pH approximately 8.5, release of soluble phosphate was rapid and averaged 56.2% within 90 minutes. Chemical suppression of phosphate release under anoxic conditions was accomplished by the addition of sulfate salts. Magnesium sulfate was effective with the inhibition of phosphate release a direct function of the amount of MgSO4 added, 50% inhibition with a 2% solution; Sodium sulfate was not effective. A relationship between ORP and phosphate release was sought but not found. The results of the study indicated an initial uptake of phosphorus greater than the accepted C/P ratio and the conclusions attribute cell lysis as the major cause of activated sludge phosphate release. (Morgan-Texas)
W70-06084

SEWAGE TREATMENT IN RURAL AREAS,
T. G. Faulkner.
Water Pollution Control Vol 68, No 4, p 443-448, July-Aug., 1969.

Descriptors: *Rural areas, *Waste water treatment, Pumping, Sludge treatment, Sludge disposal, Design standards, Operations, Sewage districts.
Identifiers: Main drainage.

In 1944 the Rural Water Supplies and Sewerage Act (England) placed a charge on the rural district as a whole to provide needed financial assistance for construction of sewage works. The question of regional main drainage or drainage for one or two villages together can be answered only after engineering studies are made. Pumping plants should be selected from engineering considerations regardless of price since pumps will operate with minimum attention in rural areas. Treatment works should be designed for minimum labor. Trade effluents and storm flows must be added to the domestic flows for design. Septic tanks, biological filters, or packaged plants may be used for treatment. Sludge from small works can best be treated at a central point. Operation and control should be done by traveling gang or by inspectors in cases where a resident manager is not justified. (Berryhill-Texas)
W70-06085

SURVEY OF WASTE WATER RATES AND CHARGES,
Sewer Dept., Lafayette, La. Utilities System.
E. E. Dupre.
Journal Water Pollution Control Federation, Vol 42, No 1, p 33-43, Jan 1970. 1 tab.

Descriptors: *Costs, *Rates, *Sewers, Taxes, Waste water treatment, Population.
Identifiers: *Charges, *Expense, Revenue.

The Lafayette, Louisiana, Sewer Department served three cities in each state of the U.S. to determine the types and basis for waste water rates and charges applied. Seventy-two cities responded. A tabulation of these data is included. The data include: location, charges for extention of sewers, population, terrain, type of waste water treatment, influent BOD, average BOD removal, number of personnel, sources and amounts of revenue, payroll costs, and current sewer rates. (Bishop-Texas)
W70-06086

WATER AND POLLUTION CONTROL IN THE IRON AND STEEL INDUSTRY, WITH SPECIAL REFERENCE TO THE SOUTH AFRICAN IRON AND STEEL INDUSTRIAL CORPORATION,
Pretoria Steel Works (South Africa).
J. J. Heynike, and F. V. Von Reiche.
Water Pollution Control, Vol 68, No 5, p 569-573, Sept.-Oct 1969. 1 fig, 4 tab, 2 ref.

Descriptors: *Water reuse, *Industrial waste, *Waste treatment, Dissolved solids, Sprinkler irrigation.
Identifiers: South Africa, Iscor works, *Steel industry wastes.

Due to fresh water shortages the Pretoria and Vanderbijlpark steel works of Iscor (South Africa) draw 1100 to 1250 gallons water/short ton of steel produced while adhering to an effluent standard of 1200 mg/l dissolved solids. Several water re-use schemes employed to minimize water usage are described including recycle of blowdown from one process as make-up for another. Processes such as acid pickling and blast furnace gas washing impart or high inorganic dissolved solids content to water. To avoid expensive dimineralization these highly polluted waters are acceptable for consumptive uses such as slag granulation, or as irrigation water for crops. Six to eight inches per year of gas-scrubbing effluent from blast furnaces may be spray-irrigated on Eragrositis Curvula grass imparting 480-600 pound N per acre per year. The individual methods of disposal of effluent from seven main production units are described. Final effluent standards and actual effluent analysis are given. The cost of waste treatment is 1 1/2 to 2 percent of the overall costs of a steel mill. (DiFilippo-Texas)
W70-06088

CONTROL OF ACTIVATED SLUDGE BY MEAN CELL RESIDENCE TIME,
California Univ., Berkeley. Sanitation Engineering Research Lab.
David Jenkins, and Walter E. Garrison.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1905-1919, Nov 1968. 6 fig, 2 tab, 15 ref.

Descriptors: *Kinetics, *Activated sludge, *Chemical oxygen demand, *Wate water treatment, Design, Operation, Microorganisms, Nitrification.
Identifiers: *Menad equation, Volatile suspended solids (VSS), Pamona, California.

A rational description of activated sludge process is presented, with demonstration of the way in which the effect of process variables can be predicted and design and control principles improved. Using a modified Monod equation, substrate removal rate and mean cell residence time based on chemical oxygen demand removed per pound of volatile suspended solids are calculated. Basing activated sludge design parameters on mean cell residence time the authors show that the data from the Pamona Water Renovation Plant in California compare favorably with other studies. Results show that substrate removal rate and mean cell residence time are kinetically rational design, control, and operating parameters and are related. A standard rate of 0.2 0.5 lbs BOD/day/lb VSS compared to a mean cell residence time of between 5 - 15 days. A sample calculation is included. (Hancuff-Texas)
W70-06089

INCREASED LOADINGS ON DIGESTERS WITH RECYCLE OF DIGESTED SOLIDS,
Illinois Univ., Urbana.
John T. Pfeffer.
Journal Water Pollution Control Federation, Vol 40, No 11, Part 1, p 1920-1933, Nov. 1968. 10 fig, 1 tab, 10 ref.

Descriptors: *Anaerobic digestion, *Operation, Digestion, *Waste water treatment, Methane bacteria.
Identifiers: *Solids retention time, *Loading rate, Recycle, Volatile solids, Acid fermentation.

Recycle of digested solids from the secondary digester back to the primary digester offers a means of increasing the loading rates with a dilute feed sludge while maintaining the solids retention time (SRT) necessary for stabilization. The increase in SRT associated with recycle produces an increase in the reduction of volatile solids, an increase in total gas production, and a more stable digestion system. Controlling factors are the concentration of solids in return cycle sludge and the ratio of the desired solids retention time to the liquid retention time. A specific example is cited in which the recycle of digested sludge increased the volatile solids destruction from an average of 44,000 lbs/day to 53,000 lbs/day. The additional solids destruction also was reflected in the reduction of the volatile content of the digested sludge from 59.4% to 53.5% during recycling. Methane fermentation of the volatile acids has been found to be the rate limiting step in high rate digestion for 10-15 day systems, acid fermentation after 15 days. (Hancuff-Texas)
W70-06090

APPLICATION OF DIGESTION THEORY TO DIGESTER CONTROL,
Iowa Univ., Iowa City.
Richard R. Dague.
Journal Water Pollution Control Federation, Vol 40, No 12, p 2021-2032, Dec 1968. 3 fig, 3 tab, 33 ref.

Descriptors: *Anaerobic digestion, *Control, *Digestion, Sludge treatment, Methane bacteria, *Waste water treatment, Operations, Hydrogen ion concentration.

The successful operation of anaerobic digestion systems depends on the control of bacteria, food, contact time, temperature, pH, and toxic materials. Stabilization of raw sludge depends on the production of methane gas through an assembly-line-like process involving acid forming and methane forming bacteria. The methane producing assembly line can be operated at peak efficiency and stability by: (1) controlling the bacterial population which here refers to methane formers, (2) providing for uniform feeding with respect to both time and consistency, (3) adequate contact time determined through the solids retention time (SRT) not simply the hydraulic retention time, (4) uniform temperature which should be provided through adequate mixing and maintained at approximately 95 degree F, (5) suitable pH not dropping below pH of 6.5, and (6) eliminating excessive concentrations of toxic materials. This paper presents a discussion of the basic requirements and indices of digestion and the manner in which the basic requirements should be applied to digester control. (Hancuff-Texas)
W70-06093

HYDROLOGIC ASPECTS OF FEEDLOT WASTE CONTROL,
Iowa State Water Resources Research Inst., Ames.
Richard R. Dague, Wayne L. Paulson, and Kenneth J. Kline.
Available from the Clearinghouse as PB-191 248, $3.00 in paper copy, $0.65 in microfiche. Iowa State Water Resources Research Institute Report No. 69-2, Iowa University, 1969. 37 p, 13 fig, 10 tab, 7 ref. OWRR Project A-022-IA.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.
Identifiers: Feedlot wastes, Waste management.

The hydrologic factors that require consideration when designing systems for the control of cattle feedlot runoff are considered. A discussion of several methods of controlling feedlot wastes is presented. Significant conclusions: (1) A significant reduction in water pollution from cattle feedlot run off can be accomplished by employing relatively simple and inexpensive runoff control facilities. The size of such facilities can be determined using established techniques for hydrologic and water quality analyses; (2) Using procedures similar to those described herein, it would be possible for control agencies to establish the minimum size of runoff control facilities for each region or major stream basin for each of several possible ultimate runoff disposal practices; and (3) Caution should be exercised in applying the term 'population equivalent' to cattle feedlot wastes. Any use of the term must consider the fact that the fraction of the total waste that enters water is extremely variable from one location to another and is heavily dependent upon the quantity and time variation in precipitation, the cattle density on the feedlot, and the topographic characteristics of the lot.
W70-06095

SECONDARY TREATMENT OF POTATO PROCESSING WASTES - FINAL REPORT,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
Kenneth A. Dostal.
Federal Water Pollution Control Administration Technical Project Report No FR-7, July 1969. 63 p, 10 fig, 10 tab, 14 ref, append.

Descriptors: *Sewage treatment, *Potatoes, *Waste water treatment, *Idaho, Anaerobic digestion, Aerobic treatment, Oxygen demand, Biochemical oxygen demand, Ammonia, Nitrogen.
Identifiers: Potato processing wastes, Snake River (Idaho).

Three pilot lagoons were used to study potato waste treatment from October 1966 through June 1968. One of the lagoons received primary clarifier effluent and was operated as a surface-aerated, aerobic unit. A second pond also received clarifier effluent but was operated as a completely-mixed, covered anaerobic unit. The effluent from the anaerobic unit was pumped into a third pond which contained a surface aerator. Hydraulic and organic loadings were varied to yield a variety of results. Both systems are economically feasible; the choice would depend upon local costs and conditions. The BOD in these potato wastes was reduced 90 percent or more. No chemical additions were necessary for either pH control or inorganic nutrient adjustment. (Knapp-USGS)
W70-06161

CHEMICAL METHODS FOR THE REMOVAL OF NITROGEN AND PHOSPHORUS FROM SEWAGE PLANT EFFLUENTS,
Wisconsin Univ., Madison. Hydraulic Lab.; and Wisconsin Univ., Madison. Sanitary Lab.
Gerard A. Rohlich.
Algae and Metropolitan Wastes, Robert A Taft Santiary Engineering Center, Cincinnati, Ohio, Technical Report SEC TR W-61-3, p 130-135, 1961. 3 fig, 7 ref.

Descriptors: *Phosphorus compounds, *Nitrogen compounds, *Sewage treatment, *Sewage effluents, Eutrophication, Pollution abatement, Water pollution control, Water pollution sources, Diatomaceous earth, Electrolysis, Chemical precipitation, Sanitary engineering, Wisconsin, Ion exchange, Aeration, Nitrates, Ammonia, Organic compounds.
Identifiers: *Chemical processes, *Nutrient removal, Organic nitrogen compounds, Guggenheim process, Ferrous sulfate, Ferric sulfate, Cupric sulfate, Aluminum sulfate, Process design, Madison (Wis), Pilot plant studies, Laboratory studies, Strong base anionic exchangers, Amberlite IR-120, Amberlite IRA-410, Nalcite SAR, Nalcite HCR.

Various chemical methods have been proposed for removal of plant nutrients in secondary sewage treatment plant effluents. Phosphorus compounds can be removed by electrolytic treatment or chemical precipitation. Since soluble nitrogenous compounds are inefficiently removed by precipitation, ion exchange methods offer great potential. Studies of phosphate coagulation were conducted employing ferrous sulfate, ferric sulfate, cupric sulfate, diatomaceous earth, and aluminum sulfate. Cupric sulfate precipitation forms floc which cannot be satisfactorily settled. Summarized, data indicated that approximately 200 milligrams alum/liter effectively removes 96-99% soluble phosphates, about 85% biologically oxidizable organic compounds, and some 68% organic nitrogen compounds. Process requires 6- to 10-fold more coagulant than is required for clarification of surface waters for potable water supply, with similar increases in cost. Recovery and purification of aluminum floc may reduce cost by 80%. Strong base ion exchangers and nuclear sulfonic cation exchangers, both regenerated with common salt, satisfactorily remove nitrate- and ammonia-nitrogen, respectively. Latter can also be air-stripped in towers packed with Raschig rings. Two design processes are presented for removal of nitrogen and phosphorus from sewage effluents where ammonia is removed by cation exchange or by forced draft aeration. (See W70-04506) (Eichhorn-Wisconsin)
W70-06214

STUDY OF POWDERED CARBONS FOR WASTE WATER TREATMENT AND METHODS FOR THEIR APPLICATION.
West Virginia Pulp and Paper Co., Covington.

Available from the Clearinghouse as PB-191 538, $3.00 in paper copy, $0.65 in microfiche. Water Pollution Control Research Series, September, 1969. 34 p, 6 tab, 15 fig, 9 ref. FWPCA Project 17020DNQ---9/69, Contract 14-12-75.

Descriptors: *Waste water treatment, Municipal wastes, *Activated carbon, *Adsorption, Effluents, *Pores.
Identifiers: Total organic carbon, Adsorption rate, Adsorptive capacity, Roanoke (Va), Secondary effluents.

Eleven commercial and experimental powdered activated carbons were subjected to an intensive laboratory evaluation of their physical and adsorptive properties to select those best suited to treating municipal waste water and to gain insight into properties important for this application. Measurements were made of TOC (Total Organic Carbon) adsorption isotherms from Roanoke, Virginia municipal secondary effluent, pore structure, BET surface area, molasses value, decolorizing index,

iodine value, real density, suspendability, and apparent density. Correlations were made between capacities for adsorbing organic impurities from municipal secondary effluent, as measured by TOC adsorptive capacities, and carbon properties such as iodine value, molasses decolorizing index and pore structure. Aqua Nuchar and Hydrodarco were clearly superior to other commercial grades tested in TOC adsorptive capacity per unit cost. The coal-base experimental carbons, pulverized Nuchar WV-L and Nuchar WV-W, were indicated by the suspendability test to be more easily removed than other carbons. Among many pore structure parameters compared, surface area in pores greater than approximately 14 Angstroms in radius was found to give the best correlation with TOC capacity. However, the correlation was not perfect, the correlation coefficient being 0.91. TOC adsorptive capacity was indicated reasonably well by the decolorizing index test. Here, correlation coefficients in the 0.80's were obtained. It is suggested that the best carbon for adsorbing organics from municipal wastes have a broad spectrum of pore sizes. Particle size of the powdered carbons was found to strongly affect the rate of adsorption. Aqua Nuchar, Hydrodarco, and pulverized Nuchar WV-L are recommended for further study.
W70-06264

THE CENTRIFUGAL RECOVERY OF WOOL GREASE,
C. H. Anderson.
Wool Science Review, Vol 37, p 23-36, October 1969. 7 ref, 11 fig.

Descriptors: *Centrifugation.
Identifiers: *Recovery (Waste), *Wool grease, *Wool scouring, Textile mill wastes.

Recovery of wool grease from scouring liquors is important to the wool industry for two reasons: (1) it is profitable; (2) pollution by putrefiable fleece components is prohibited in many places. Scouring liquors will separate into 3 phases: (1) upper phase - mainly grease, (2) intermediate phase - retains aqueous detergent solution plus a small amount of wool grease, (3) lower=level heavy dirt particles. The process described has three centrifugations. The first has the primary objective of removing dirt from the liquor and producing a wool grease concentrate containing 15 plus or minus 5 percent at maximum yield. The primary conglomerate from the first centrifugation is centrifuged to remove some of the fine sludge remaining after primary separation and to concentrate the product to a grease content of at least 70%. The purifier centrifuge removes the remaining water and fine sludge particles from the secondary conglomerate. The best conditions for scouring are also the best for wool grease recovery, the essential thing being to remove as much grease as possible in the first hot bowl. (Robinson-North Carolina State Univ)
W70-06265

PROCESS WATER AND PROBLEMS ASSOCIATED WITH TEXTILE EFFLUENT,
F. H. Slade.
Textile Manufacturer, Vol 94, p 14-18, 1968. 10 fig.

Descriptors: *Coagulation, *Supply water, *Centrifugation, Sedimentation, Flocculation, Separation techniques, Water softening, Ion exchange.
Identifiers: Aluminum sulphate, Sedimentation tanks, Continuous sand filter, Pressure filters.

A large portion of water intake may be effluents of other manufacturers and will contain many substances produced by them. All contaminants produce special treatment problems which are further complicated by the probability of many unit processes discharging their waste products at the same time. Water received from public supply will not require treatment other than as demaned by special processes. Basically, the method of purification is the same for all waters with the variables of character and amount of contained impurities influencing details of plant design and chemical treatment necessary. The impurities must first be coagulated to permit removal by filtration or by sedimentation followed by filtration. Aluminum sulphate is the most common coagulate: a low pH responds well to coagulation. The purpose of sedimentation is to remove the maximum amount of turbidity from the water and so reduce the filter loading. Clarification may also be achieved by centrifugation. Waters may be clarified in gravity or pressure filters. The use of a water-softening plant enables many textile processes to be carried out irrespective of locality. The ion exchange method is the most efficient for producing soft water. (Robinson-North Carolina State Univ)
W70-06266

MECHANICAL TREATMENT OF EFFLUENT (IN RUSSIAN),
L. V. Krasovskii.
Tekstil'Naia Promyshlennost, Vol 27, No 10, p 61-62, 1967.

Descriptors: *Screens.
Identifiers: *Sand traps, *Settling tanks, *Textile mill wastes, Mechanical treatment, Fiber wastes, Dyestuffs.

The use of screens, sand traps, and settling tanks in the treatment of textile-processing effluent containing fiber bits of fabric, insoluble particles of dye, and chemical auxiliaries is discussed. (Livengood and Robinson-North Carolina State Univ)
W70-06267

INDUSTRIAL MEASURES FOR THE PURIFICATION OF AIR AND WATER (IN GERMAN),
M. Kehren.
Textilveredlung, Vol 1, No 5, p 219-227, 1966.

Descriptors: *Pilot-plant.
Identifiers: *Mechanical filtration, *Electrostatic precipitation, *Air cleaners.

The large-scale developments and the plant at Farbwerke Hoechst are described. Mechanical filtration and electrostatic precipitation are used in air cleaners. A pilot-scale water treatment plant has been used to develop a full-scale effluent and water plant dealing with 24,000 cu m per day. (Livengood and Robinson-North Carolina State Univ)
W70-06268

IN PLANT PROCESS CONTROL FOR ABATEMENT OF POLLUTION LOAD OF TEXTILE WASTES,
S. V. Ganapati.
Environmental Health (India), Vol. 8, No. 3, p 169-173, 1966.

Descriptors: Biochemical oxygen demand, Detergents, Heat exchangers.
Identifiers: *Starch, *Sizes (Slashing), *Polyvinyl alcohol, *Carboxymethylcellulose, Waste heat recovery, Dyehouse wastes, Acetic acid, Desizing, Textile mill wastes.

The procedures for the reduction of waste at a textile mill are discussed. It is possible to reduce the volume and strength of the waste by recovery of certain salvageable substances and to recover much waste heat from the processes. A significant quantity of pollution results from the desizing process. This can be reduced by utilizing chemicals with a lower BOD, such as synthetic sizing agents. (C. Livengood and Robinson-North Carolina State Univ)
W70-06269

WASTE DISPOSAL SYSTEMS - HOW THEY SHAPE UP TODAY,
R. W. Pinault.
Textile World, Vol. 114, p 100-110, June, 1964. 9 figures.

Descriptors: *Sewage disposal, *Oxidation lagoons, *Aeration flocculation, Chemical precipitation.
Identifiers: *Chemical treatment, Dyehouse wastes, Slashing wastes, pH treatment, Biosorption process, Textile mill wastes.

Four basic approaches can be used to improve plant effluent. Chemical treatment is the most expensive and depends on flocculation and precipitation. This process neutralizes pH and traps most of the color in the sludge. The second approach is a full-scale sewage disposal plant which needs some adaptation before handling mixed wastes. The third method is an oxidation pond. This process may meet local treatment requirements. However, it is only minimum treatment. The ambient temperature must be warm enough to promote bacterial growth. The last method is an aerated lagoon which is a biosorption process. Air is added to a lagoon system by mechanical agitation or by compressed pumping. This is inexpensive and does not provide for sludge disposal. Some plants use flue gas to reduce pH and thus makes waste disposal easier. Surfactants of the branched-chain type of alkl-benzene sulfonates have almost completely replaced soaps in many textile processes. Soaps have been problems because their foams were nearly indestructible. (Robinson-North Carolina State Univ)
W70-06271

PRECIPITATION OF DIRECT DYE BY FERROUS SULFATE,
Society of Chemical Industry, Tokyo (Japan).
H. Iida.
Kogyo Kagaku Zasshi, Vol. 67, p 210-213, 1964.

Descriptors: *Chemical precipitation.
Identifiers: *Precipitation, *Direct dyes, *Ferrous sulfate, Dyestuffs, Clarification, Dyehouse wastes.

In order to obtain basic data for the clarification of waste water containing dyes, experiments on the precipitation of five direct dyes in aqueous solution were carried out by the addition of ferrous sulfate. The purified dye was dissolved in water and ferrous sulfate. Solution was added to the solution under various conditions. The precipitate formed was separated by centrifugation and the remaining dye in the filtrate was determined by colorimetry. (Livengood and Robinson-North Carolina State Univ)
W70-06272

POLLUTION FACTORS AND TREATMENT OF TEXTILE WASTE WATERS,
For primary bibliographic entry see Field 05B.
W70-06273

STREAM POLLUTION AND EFFLUENT TREATMENT, WITH SPECIAL REFERENCE TO TEXTILE AND PAPER MILL EFFLUENTS,
L. Klein.
Chemistry and Industry, p 866-873, 1964.

Descriptors: *Sedimentation, *Flocculation, *Activated sludge, Legislation, Biological treatment, Lagoons, Anaerobic digestion.
Identifiers: *Textile mill wastes, *Paper mill wastes, *Percolating filters, Clarification, Stream pollution, Effluent treatment, Physical treatment, Chemical treatment.

The polluted condition of the river Irwell and other rivers in Lancashire and recent legislation to control pollution are discussed. General measures are indicated that can be taken by industry to reduce the volume and strength of waste waters, including process changes, re-use of waste waters, and recovery of by-products. The polluting materials present in waste waters from pulp and paper mills and from textile mills, the effects of the waste waters on receiving streams, and methods of treating these waste waters by physical, chemical and biological processes are all discussed. A bibliog-

raphy of 29 references is appended. (Livengood and Robinson, North Carolina State Univ)
W70-06274

WASTE WATER IN THE TEXTILE INDUSTRY,
M. Kehren.
Melliand Textilberichte, Vol. 43, p 1217-1222, 1962.

Descriptors: *Sedimentation, *Activated sludge.
Identifiers: *Niers process, *Turicit process, *Textile mill wastes, Chemical treatment, Mechanical treatment, Biological purification, Clarification.

The chemical and mechanical means of achieving biological purification and clarication of textile waste water by the following methods are discussed: by settling media, by activated sludge, and by the Niers and Turicit Methods of mechanical clarification preceeding biological treatment. (Livengood and Robinson-North Carolina State Univ)
W70-06275

WASH-WATER RECOVERY CUTS MERCERIZING COSTS,
R. W. Pinault.
Textile World, Vol. 106, p 107, February 1956. 2 figures.

Descriptors:
Identifiers: *Caustic, *Recovery (Waste), *Zaremba evaporator, Textile Mill wastes, Mercerizing wastes.

Fairforest Finishing Division of Reeves Brothers, Inc., recently put a Zaremba evaporator into use to reconcentrate mercerizer wash water. The unit saves caustic and reduces alkalinity of the finishing plant effluent. The water treated contained 4-8% sodium hydroxide. The waste water is 506% less alkaline than before treatment by the Zaremba evaporator, and chemical treatment for neutralization is correspondingly less. The mercerizer wash water is pumped through a hard-coal filter. After filtration, the weak caustic is pumped to a receiving tank, where it is then pumped into the stream chest of the Zaremba recovery system. In a heat-exchange process, the caustic is brought to a boil and discharges into the evaporating chamber. The flow of weak caustic into the stream chest and discharge of 40% caustic from the evaporator are automatic. (Robinson-North Carolina State Univ)
W70-06276

TEXTILE WASTE PROBLEMS,
For primary bibliographic entry see Field 05A.
W70-06277

BEHAVIOR OF SULFIDES AND SULFUR DYES IN WASTE WATER,
M. Kehren, and H. Denks.
SVF Fachovgan Textilveredlung, Vol. 12, p 138-153 and 492-498, 1957.

Descriptors: *Sulfides, Waste water treatment, Aeration, Carbon dioxide.
Identifiers: *Sulfur dyes, *Dyehouse wastes, Sodium sulfide, Hydrochloric acid, Precipitation.

In waste waters containing sulfides and sulfur dyes, sodium sulfide is removed by treatment with hydrochloric acid or a mixture of carbon dioxide and air, followed by aeration. Almost insoluble sulfur dyes cannot be precipitated by aeration or carbon dioxide alone, but can be removed by treatment with mixtures of carbon dioxide and air. Soluble sulfur dyes can only be precipitated with salts of heavy metals at a pH 5.5. (Livengood and Robinson-North Carolina State Univ)
W70-06278

SUPPLY TREATMENT AND DISPOSAL OF WATER IN THE DYEHOUSE,
R. W. Richardson.
Journal of the Society of Dyes and Colourists, Vol. 73, p 485-491, 1957. 1 ref.

Descriptors: *Water supply, Calcium, Magnesium, Iron, Alkalinity, Acidity, Ponding, Flocculation, Water softening, Ion exchange, Zeolites, Water analysis, Temperature, Detergents, Neutralization, Biochemical oxidation demand, Costs, Economics.
Identifiers: *Dyehouse wastes, *Chemical purification, Aluminum hydroxide, Bacterial filter bed.

The three sections of this paper discuss (1) supply, (2) treatment and (3) disposal. The water supplies in England can be divided into three types, each having its particular advantages and disadvantages. Few dyehouses are located so conveniently that some sort of purification is not necessary. The chief impurities in a water supply from the point of view of use for textile purposes are particulate and colloidal matter colour, 'hardness salts' and other interfering metal ions, acidity, and alkalinity. Clarification may be brought about by ponding, and many times aluminum hydroxide must be added as a flocculation. Two main types of water softening systems are now used: ion exchange and chemical purification. Water analysis is discussed in connection with water softening. Dyehouse effluents can be divided into three main types: wool, cotton, and mixed man-made fiber wastes. The differences in character are due mainly to the various preparatory processes carried out. The polluting effect of a textile waste results from the high organic matter content, which acts by depriving the stream of its dissolved oxygen. The temperature of an effluent also has as important an effect as the polluting waste itself. A rise in the temperature of a stream reduces its capacity to hold dissolved oxygen and at the same time increases the rate at which biological deoxygenation takes place. (Robinson-North Carolina State Univ)
W70-06279

WASTE WATERS FROM THE WOOL INDUSTRY (IN RUSSIAN),
For primary bibliographic entry see Field 5B.
W70-06280

BLEACHERY AND DYEHOUSE WASTE STUDIES,
Cannon Mills Co., Kannapolis, N.C.
John L. Brown, Jr.
American Dyestuff Reporter, Vol. 44, No. 12, p 385-386, 1955.

Descriptors: Heat exchangers.
Identifiers: *Bleaching wastes, *Dyehouse wastes, Segregation, Textile mill wastes, Acidic wastes, Alkaline wastes, Bleaching.

A study of Cannon Mills' waste problems showed the following results (1) standardization of bleachery processes reduces waste strength and lowers cost. (2) Re-use of cleaner water lowers water consumption about 10%. (3) Fine screens installed ahead of heat exchangers remove fibers and increase efficiency. (4) It is economically feasible to treat and refilter a sizeable quantity of water. The segregation of three categories of wastes was found feasible: (1) acid, (2) strongly alkaline, and (3) mildly alkaline wastes. In the proposed treatment plan, the first two categories will be treated separately and added to the remaining industrial waste and domestic sewage for final treatment. Storage of the acid and strongly alkaline wastes allows seven-day operation of the treatment plant. (Sheffield-North Carolina State Univ)
W70-06281

TEXTILE-WASTE TREATMENT IN TEXAS,
Texas State Dept. of Health, Austin. Bureau of Sanitary Engineering.
D. F. Smallhorst.
American Dyestuff Reporter, Vol. 44, No. 12, p 386-389, 1955. 8 tab.

Descriptors: *Domestic wastes, Coagulation, Chemical analysis, Lagoons, Oxidation lagoons.
Identifiers: *Indigoid dyes, *Dyehouse wastes, *Finishing wastes, *Slashing wastes, Textile mill wastes.

Over several years the Texas Textile Mill attempted to find a type of treatment for textile waste permitting it to be further purified in a domestic sewage plant without affecting the plant's operating efficiency. Recommendations on coagulation, flow studies, chemical analysis, and measurements of waste volume were made. Wastes were grouped into four categories: indigo, dyehouse, finishing, and slashing wastes. A lagoon for dye waste gave remarkable clarification and emitted little hydrogen sulfide odor. Now the mill waste is seeded with domestic sewage and put in oxidation ponds where organisms remove organic matter. (Sheffield-North Carolina State Univ)
W70-06282

BIOLOGICAL TREATMENT OF MIXTURES OF HIGHLY ALKALINE TEXTILE-MILL WASTES AND SEWAGE,
Cone Mills Corp., Greensboro, N.C.
R. H. Souther, and T. A. Alspaugh.
American Dyestuff Reporter, Vol. 44, No. 12, p 390-395, 1955. 1 figure, 10 tables, 7 references.

Descriptors: *Trickling filters, *Activated sludge, Pilot plants, Alkalinity, Biological treatment, Domestic wastes.
Identifiers: Textile mill wastes.

Results of a pilot-plant study by Cone Mills show that a mixture of up to 40% highly alkaline effluent with 60% domestic sewage can be biologically treated without pretreatment. The most successful method tested employed a high-rate trickling filter and activated sludge both of which were acclimated to highly alkaline waste. BOD removal averaged 93%; pH was lowered from 10.0-11.4 to 7.9-8.5; 95% of suspended solids was removed; the final effluent was odorless and colored with a tinge of yellow. Shock loads did not destroy the system, but at pH above 11.4 efficiency of operation dropped. (Sheffield-North Carolina State Univ)
W70-06283

DESIGN AND COST OF LIQUID - WASTE DISPOSAL SYSTEMS,
Alabama Univ., University. Natural Resources Center.
Charles D. Haynes, and David Grubbs.
Available from the CLearinghouse as PB-191 535, $3.00 in paper copy, $0.65 in microfiche. Report 692, Natural Resources Center, University of Alabama, Dec. 1969. 110 p, 21 ref, 36 fig, 2 tab. OWRR Project B-019-ALAS (1).

Descriptors: *Liquid wastes, *Water disposal, Deep wells, Computer programs, Computer models.
Identifiers: *Texas curve.

Amethod of liquid-waste disposal is injection into subsurface reservoirs. The cost of disposal is an overriding consideration in determination of the feasibility of deep-well disposal. Physical and engineering limitations in the design of the system are considered. Also considered is the capital investment in the treatment plant, the pipeline, and the disposal well. A third section is a computer program affording a highly flexible procedure for design and estimation of deep-well disposal systems. Four combinations of design procedures are offered: (1) Steady-state flow question in combination with the Texas curve of average treatment plant costs; (2) Pressure buildup subroutine in combination with the Texas curve to obtain plant cost; (3) Steady-state flow equation combined with PLANT subroutine for treatment plant cost; and (4) Plant buildup subroutine combined with PLANT subroutine. A print-out of the program is included. (Grossman-Rutgers)
W70-06311

THE PROBLEM OF AGRICULTURAL POLLUTION IN WATER TREATMENT,
Pawtucket Water Dept., R.I.
John A. McManus, and Albert A. Zalfa.
Journal of the New England Water Works Association, Vol. 83, No. 4, p 311-321, Dec. 1969. 11 p, 2 tab, 2 fig.

Descriptors: *Water pollution sources, *Animal wastes, *Fertilizers, Farm wastes, Water pollution treatment, Legal aspects.
Identifiers: *Pawtucket (Rhode Island).

The main concern of the Pawtucket, Rhode Island water supply system is the problem of pollution due to farmers using animal wastes for fertilizer. Due to the lack of large reservoir at the lowest end of the drainage basin feeding the treatment plant, the results of the animal wastes on the fields are severe at the point of treatment. The drainage and the seasonal usage of the water supply system are described: The pollution problem is in part attributed to one cattle company which hauled their waste material into the basin and deposited the solid and liquid wastes in great quantities. Because of the lack of dilution or detention time, high bacterial levels resulted. A schematic diagram of the water treatment plant is shown and its capabilities are described. The problem is that existing state law does not allow the prohibition of fertilizing agricultural land with animal wastes, even if such methods result in water pollution. (Grossman-Rutgers)
W70-06314

5E. Ultimate Disposal of Wastes

HYDROGEOLOGIC INFORMATION ON THE GLORIETA SANDSTONE AND THE OGALLALA FORMATION IN THE OKLAHOMA PANHANDLE AND ADJOINING AREAS AS RELATED TO UNDERGROUND WASTE DISPOSAL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-05922

SEEPAGE AND SEEPAGE CONTROL PROBLEMS IN SANITARY LANDFILLS,
Los Angeles County Sanitation District, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W70-06011

FARM WASTES,
Netherlands Government Agricultural Waste Water Inst., Arnhem.
For primary bibliographic entry see Field 05D.
W70-06056

WASTE DISPOSAL FROM WATERCRAFT,
Cargo Carriers, Inc., Minneapolis, Minn.
For primary bibliographic entry see Field 05D.
W70-06070

MECHANICAL DEWATERING OF MIXED SLUDGES AT ANDOVER,
For primary bibliographic entry see Field 05D.
W70-06071

UNDERGROUND DISPOSAL OF ACTIVATED SLUDGE,
Dow Chemical Co., Midland, Mich.
E. S. Shannon.
Journal Water Pollution Control Federation, Vol 40, No 12, p 2059-2061, Dec 1968. 2 fig.

Descriptors: *Activated sludge, *Sludge disposal, *Deepwell, Industrial wastes, Injection, Injection wells, Wells, Waste water.
Identifiers: *Dow Chemical, *Midland (Mich).

The deepwell disposal has been used successfully for many years by a chemical manufacturing plant at Midland, Michigan to dispose of unmarketable by-product chemicals, brines, and high BOD wastes. Since 1963 excess activated sludge from the plant's waste water treatment facility also has been injected into underground formations. The activated sludge disposal well system consists of a 100 ft diameter thickener, two sludge holding tanks, 1 sludge forwarding station, 4 high pressure pumps, and 2 disposal wells. In operation excess activated sludge at about 1.5% solids is pumped to the thickener where the concentration is increased to about 2.5% solids. Injection pressures are kept below levels that would cause fracture of receiving formations. (Hancuff-Texas)
W70-06077

DESIGN AND COST OF LIQUID - WASTE DISPOSAL SYSTEMS,
Alabama Univ., University. Natural Resources Center.
For primary bibliographic entry see Field 05D.
W70-06311

5F. Water Treatment and Quality Alteration

EFFECT OF ANTIBACTERIAL AGENTS ON MINE DRAINAGES, USE OF VIABLE ANTIBACTERIAL AGENTS TO REDUCE POLLUTION BY MINE DRAINAGES,
MSA Research Corp., Evans City, Pa.
For primary bibliographic entry see Field 05G.
W70-05959

GUIDELINES AND CRITERIA FOR COMMUNITY WATER SUPPLIES IN THE DEVELOPING COUNTRIES.
Bureau of Water Hygiene, Rockville, Md.

Available from the Clearinghouse as PB- 189 255, $3.00 in paper copy, $0.65 in microfiche. Environmental Control Administration, Bureau of Public Hygiene report, Washington, DC, 1969. 108 p.

Descriptors: *Water supply, *Standards, Municipal water, Water polltuion control, Urbanization.

The report is a synthesis of ideas on guidelines and criteria developed from team surveys of community water supply programs in twelve developing countries, four of them in Asia and eighth in Latin America. The purpose was to examine AID operations in this field and identify those factors contributing to the development of successful projects as well as those hindering such development. Chapters are devoted to policies, laws and institutions, program planning, capital financing, manpower and training, technical standards, project development, contracts and construction, operation and maintenance, water utility management and developing public support.
W70-05975

MINIMUM DESIGN STANDARDS FOR COMMUNITY WATER SUPPLY SYSTEMS.
Federal Housing Administration, Washington, D.C.

Available from the Clearinghouse as PB-189 258, $3.00 in paper copy, $0.65 in microfiche. Federal Housing Administration Report No 751, Wash DC, July, 65, 76 p.

Descriptors: *Water supply, *Standards, Municipal water, Water treatment, Water pollution control, Sanitary engineering.

This study sets forth minimum design standards acceptable to FHA for water supply production, treatment, pumping, storage, and distribution facilities to serve properties offered as security for mortgage insurance. These minimum design standards apply to central water systems serving residential neighborhood developments and multifamily projects.
W70-05976

COUNTY BOARD OF HEALTH (GENERAL POWERS AND DUTIES).
NJSA sec 26:11-10 (i) (1964).

Descriptors: *New Jersey, *Administrative agencies, *Waste disposal, *Public health, Legislation, Regulation, Legal aspects, State governments, Local governments, Permits, Drainage, Waste water disposal, Environmental sanitation, Animals, Birds, Sewers, Sewage disposal, Septic tanks, Cesspools, Ultimate disposal, Garbage dumps, Landfills, Wastes, Waste dumps, Plumbing.

The county boards of health shall have the powers: (1) to aid in the enforcement of all laws applicable to the preservation of human life and health; (2) to charge a reasonable fee for licenses issuable under this chapter; (3) to insure sanitary conditions in all public buildings in the county; (4) to regulate the plumbing, ventilation and drainage of every building in the county and to require plans for such to be submitted for approval; (5) to prohibit or regulate any noxious businesses; (6) to regulate all dealers in bones, fat and animal offal and any establishments for boiling fat or greasemaking; (7) to regulate accumulations of manure or other decaying matter; (8) to regulate and control night soil scavengers and the cleaning of any privies, cesspools or sinks; (9) to regulate the cleaning of sewers and the dumping of garbage; (10) to provide for the filling of sunken lots that are repositories for stagnant waters; (11) to regulate and control the keeping or slaughtering of animals, birds and beasts. (Barnett-Florida)
W70-06020

THE RECLAMATION OF POTABLE WATER FROM SEWAGE,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 05D.
W70-06083

RAW WATER QUALITY CRITERIA FOR PUBLIC SUPPLIES.

Journal American Water Works Association, Vol 61, No 3, p 133-138, Mar 1969. 6 p, 10 ref, 2 tab.

Descriptors: *Water quality, *Potable water, *Water supply, *Water properties, Domestic water, Impaired water quality, Color, Hardness (Water), Mineralogy, Nitrates, Odor, Pesticide residues, Public health, Radioactivity, Standards, Turbidity, Water, Water analysis, Water purification, Water quality control, Water softening, Pollutants, Water pollution sources, Coliforms.

Prepared by the National Technical Advisory Committee on Public Water Supplies, this report lists raw-water quality criteria for potable water supplies. Distinction is made between permissible and desirable criteria. Permissible criteria are those which result in the production of minimally satisfactory water whereas desirable criteria exceed such minimum standards. Listed criteria govern: (1) color; (2) odor; (3) temperature; (4) turbidity; (5) coliform and fecal coliform organisms; (6) alkalinity; (7) ammonia; (8) arsenic, barium, cadmium, chromium (hexavalent), copper, chloride, cyanide, iron, lead, manganese, phenols, selenium, silver, sulfate, zinc and radioactive substances; (9) boron; (10) dissolved oxygen; (11) fluoride; (12) hardness; (13) nitrate plus nitrite; (14) pH; (15) phosphorus; (16) total dissolved solids; (17) uranyl ion; (18) carbon chloroform extract; (19) methylene blue active substances; (20) oil and grease; and (21) pesticides and herbicides. (Marsee-Florida)
W70-06193

5G. Water Quality Control

EFFECT OF ANTIBACTERIAL AGENTS ON MINE DRAINAGES, USE OF VIABLE ANTIBACTERIAL AGENTS TO REDUCE POLLUTION BY MINE DRAINAGES,
MSA Research Corp., Evans City, Pa.
Robert E. Shearer, and William A. Everson.
Available from the Clearinghouse as PB-191 215, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-21, November 1969. 138 p, 35 fig, 42 tab, 19 ref, 2 append. FWPCA Grant 14010 EGJ.

Descriptors: *Acid mine water, *Water pollution treatment, *Bactericides, *Inhibitors, *Acid bacteria, Antibiotics (Pesticides), Water pollution control, Mine wastes, Water quality, Water chemistry, Biocontrol.
Identifiers: Acid-bacteria inhibition, Caulobacter.

The active agents in natural waters previously found to inhibit bacterial production of acid in streams were investigated in the laboratory, and inoculations of natural water previously found to be inhibitory were made, about 14,000 gallons each, to a worked-out mine in Pennsylvania. After the first inoculation, tests showed absence of inhibitory power in the water at the time it was collected, and the water used for the second test was similarly found to be only weakly inhibitory. Strains of Caulobacter were found in the natural inhibitory waters, and when adapted to acidic environments and concentrated in culture media, they induced inhibition of acid production. Other adapted strains of Caulobacters also induced inhibition. Some evidence was shown that Caulobacter inhibitors might move downstream. Four species of Streptomyces tolerated acidic conditions, and were effective against the acid-producing bacteria in test tube cultures and on solid media. (Knapp-USGS)
W70-05959

OHIO RIVER SANITATION COMPACT.

Ohio Rev Code Ann secs 6113.01 thru 6113.04 (Page, 1953).

Descriptors: *Ohio, *Sanitary engineering, *Water pollution, *Ohio River, Legislation, Legal aspects, Interstate, River basin commissions, Interstate rivers, Water resources development, Interstate compacts, Rivers, Streams, Wastes, Municipal wastes, Sewage disposal, Sewage, Domestic wastes, Industrial wastes, Drainage, Watersheds (Basins), Drainage districts, Water pollution control.

Ohio hereby adopts the Ohio River Sanitation Compact. Other member states are Illinois, Indiana, Kentucky, New York, Pennsylvania, Tennessee, Virginia, and West Virginia. The purpose of the Compact is to foster cooperation in the control and abatement of pollution from the rivers and streams in the Ohio River Basin. The guiding principle of this compact is stated to be that pollution by sewage or industrial wastes orginating within a signatory state should not adversely affect the uses of the interstate waters. The Ohio River Valley Sanitation District and the Ohio Valley Water Commission are established by this compact. The composition, procedures, and powers of the Commission are set forth. Among the duties of the Commission are the study of pollution problems within the District, and the recommendation of uniform legislation dealing with these problems. The Commission may, after conducting appropriate hearings, order any person or municipality to terminate discharge of pollutants into interstate waters within the District. (Casey-Florida)
W70-06018

BEALS V ROBERTSON (DISCHARGE OF MINE WATER INTO A NATURAL WATERCOURSE).
356 Pa 348, 52 A2d 316-317 (1947).

Descriptors: *Watercourses (Legal), *Flow control, *Mine drainage, *Pennsylvania, Water conveyance, Ditches, Legal aspects, Judicial decisions, Water law, Drainage, Surface drainage, Nonnavigable waters, Natural flow doctrine, Natural use, Reasonable use, Mine water, Mine wastes, Relative rights.

Plaintiffs' land is lower than defendants' land, and the two are separated by an intervening parcel of land. Water discharged from a coal mine owned by defendants flowed in its natural course until it reached an abandoned ditch beside a township road. The water flowed in the ditch until it reached another natural watercourse which carried the water onto plaintiffs' land. Plaintiffs sought to enjoin defendants from discharging mine waters which reached plaintiffs' land. The court, affirming the trial court decree for defendants, held that owners of the upper land could not make new channels, nor concentrate and increase the flow of waters by artificial means, but such landowners had the right to have the water flowing from their land discharged into a natural watercourse upon the lower land. Furthermore, such owners could increase the flow through the natural and reasonable use of their land. (Powell-Florida)
W70-06021

RYALL V WATERWORKS IMPROVEMENT DISTRICT NO3 (INJUNCTION SOUGHT TO STOP CONSTRUCTION OF TREATMENT PLANT).
445 SW2d 883-884 (Ark 1969).

Descriptors: *Arkansas, *Treatment, *Remedies, *Property values, Judicial decisions, Water pollution, Legal aspects, Competing uses, Local governments, Deep wells, Sewage treatment, Relative rights, Administrative agencies, Construction.
Identifiers: *Injunctions (Prohibitory), Nuisance.

Appellants sought an injunction against the Commissioners of the Waterworks Improvement District No. 3 to stop the construction of an oxidation treatment plant for sewage. Appellants contended that the oxidation plant would be a nuisance and expressed fear that the values of their property would depreciate. One appellant feared it would affect his deep-well system. Another testified she had lost sales of her property due to the proposed location of the plant. The lower court refused to grant the injunction. The appellate court affirmed, holding that there were no facts presented which established that the plant would constitute a nuisance. The fear of what may happen is not a sufficient ground for obtaining an injunction. A prohibition is allowed under Arkansas law only when the preponderance of the testimony shows that the activity is certain to be a nuisance. (Barnett-Florida)
W70-06022

STATE AND FEDERAL AID--COMMON SEWER DISTRICTS.

Mo Ann Stat secs 204.200 thru 204.470 (Supp 1970).

Descriptors: *Missouri, *Sewage districts, *Sewage disposal, *Government finance, Waste disposal, Administration, Sewage, Domestic wastes, Municipal wastes, Sewers, Governments, Federal government, Local governments, State governments, Legal aspects, Legislation, Water law, Administrative agencies, Leadership, Cities, Financing, Costs, Rates, Grants, Cost repayment.

Under specified conditions the state may make grants to local governments for water pollution control. The State Water Pollution Board shall, consistent with federal provisions, administer such funds. Regulations are provided governing incorporation of common sewer districts and approval of incorporation by taxpayers' election. Judicial notice shall be taken of incorporated sewer districts. The county courts shall appoint a board of trustees to discharge the business of each district. Each municipality within a district shall appoint an advisory board to make recommendations to the board of trustees. Each district shall have the power of eminent domain. The costs of sewer districts may be met by expenditure of funds received legally from the state, the United States or any municipality, or from the proceeds of revenue bonds issued by the district. Bonds shall be payable solely from revenues derived from operation of the sewer system. Each district shall fix rates for sewage disposal sufficient to pay principal and interest on bonds issued by the district. Such rates shall be maintained until the bonds of the district are retired. (Dye-Florida)
W70-06024

J HUNGERFORD SMITH CO V INGRAHAM (ORDER OF HEALTH COMMISSIONER TO CEASE AND DESIST DISCHARGE OF INADEQUATELY TREATED WASTE).
301 NYS2d 266-271 (S C NY 1969).

Descriptors: *New York, *Public health, *Administrative agencies, *Administrative decisions, Legislation, Environmental sanitation, Sewage, Judicial decisions, Legal aspects, Waste treatment, Waste disposal, State governments, Regulation, Administration, Adjudication procedure, Water pollution control, Industrial wastes.

The respondent corporation was charged with discharging inadequately treated sewage and industrial wastes into New York waters. On January 26, 1967, the Commissioner of Health issued an order directing respondent to cease and desist all discharges of industrial wastes on February 1, 1967 unless actions were initiated to effect a more adequate treatment of wastes from respondent's plant on or before October 1, 1967. On January 19, 1968 respondent commenced a proceeding to review and annul the Commissioner's order. The Commissioner filed a motion to dismiss the petition as untimely under the statute of limitations. The trial court found that the Commissioner's order did not become final and binding, and thus subject to judicial review, until October 1, 1967. Therefore, since the proceeding was commenced within four months of October 1, 1967, the statute of limitations had not run. The appellate court reversed and held that the basic four-month statute of limitation was not applicable. The court reasoned that the Public Health Law required review of the Commissioner's determination to be made within sixty days after service of the determination or decision. The court also held that the Commissioner's order became final and binding upon respondent on February 1, 1967 and not on October 1, 1967 with respect to timeliness. (Powell-Florida)
W70-06026

CONTROL OF POLLUTION BY UNDERWATER STORAGE, FEASIBILITY OF PROVIDING TEMPORARY UNDERWATER STORAGE OF STORM OVERFLOW FROM A COMBINED SEWER SYSTEM.
Underwater Storage, Inc., Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-06029

AIDS TO MUNICIPALITIES FOR PREVENTION AND ABATEMENT OF WATER POLLUTION.

Wis Stat Ann sec 66.33 (1965), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Cities, *Water pollution, *Pollution abatement, Water pollution control, Water pollution treatment, Grants, Federal government, Administrative agencies, Construction, Utilities, Industries, Contracts, Sewage disposal, Sewage, Industrial wastes, Sewage treatment, Waste treatment, Coordination, Projects, Treatment facilities, Water resources.
Identifiers: Public improvements.

Any municipality may apply for and accept grants or other aid which the federal government has authorized for the construction of public improvements for water pollution abatement. Municipalities may also accept aid from commercial, industrial and other establishments to aid in water pollution abatement. Cities may contract to: collect, treat, and dispose of sewage and industrial wastes; use and operate sewage facilities owned by such establishments; coordinate municipal and industrial sewage facilities; and to construct sewage and other facilities to handle the discharges of industrial wastes. Any municipality may participate in the state financial assistance program for water resources protection and make agreements with the Department of Resource Development for that purpose. Municipalities may also make contracts for the design and construction of projects to be subleased from the Department of Resource Development. (Duss-Florida)
W70-06055

INDUSTRIAL CONTROL FACILITIES; CERTIFICATE (WATER POLLUTION ABATEMENT OR CONTROL FACILITIES).

Ohio Rev Code Ann secs 6111.31 thru 6111.40 (Page, Supp 1970).

Descriptors: *Ohio, *Water pollution control, *Treatment facilities, *Industrial wastes, Legislation, Water pollution treatment, Pollution abatement, Sewage treatment, Waste water treatment, Waste treatment, Industrial plants, Industrial water, Taxes, Regulation, Wastes, Municipalities, Legal aspects, Federal government, State governments, Water pollution, Administrative agencies, Administration.
Identifiers: *Tax exempt facilities.

Industrial water pollution control facilities that have been approved by an authorized agency are exempt from property, franchise and sales taxes. Application for approval shall be made with the Water Pollution Control Board, which notifies the taxing authority if the application is allowed. The tax commissioner or county auditor may request a hearing for reconsideration. If the application is allowed, the Board shall issue an industrial water pollution control exemption certificate. After a hearing, the certificate may be revoked or modified if the facilities are not completed or cease to be used. Appeals concerning the issuance of certificates are made to the county court. So long as the certificate is in force, the facility continues its tax-exempt status. The certificate may be transferred when the facility is transferred. Municipal corporations, county commissioners or districts may apply to the Water Pollution Control Board for state financing of sewage treatment works. The amount should be that necessary to obtain the maximum federal grants. The Board may adopt rules and regulations governing the handling of this money. (Douberley-Florida)
W70-06064

THE INDUSTRIAL WASTES CONTROL PROGRAM IN NEW YORK CITY,
Department of Water Resources, New York. Bureau of Water Pollution Control.
Charles Imbelli, William V. Pressman, and Harold Radiloff.
Journal Water Pollution Control Federation, Vol 40, No 12, p 1981-2012, Dec 1968. 11 fig, 9 tab, 7 ref.

Descriptors: *Industrial wastes, *Legislation, Costs, Pilot plants, Sampling, *Sewage treatment, *Water pollution control, Waste water treatment.
Identifiers: *New York City.

New York City's inactment of a local law for the control of industrial waste discharges to the sewer system is unique because of the variety of manufacturers and service type industries involved. In the middle thirties action was begun to unify piecemeal laws previously enacted and resulted in the Charter of 1938. In 1962 authority and responsibility for the operation of the entire sewer system was assigned to the Department of Public Works. Discussion of the law, the surcharge formula used, and the problems of program organization are covered extensively. The surcharge formula incorporates cost per pound of removing pollutants, volume of wastewater discharge, concentration of suspended solids, and biochemical oxygen demand. These surcharges are based on concentrations of suspended solids and BOD over and above 'normal sewage'. Results of pilot studies using new techniques and description of several unique waste problems, sampling methods, and equipment used are included. Several industries requiring pre-treatment were described in detail with regard to their particular problem. These wastes were industrial laundries, metal platers, acid wastes, paints and varnishes, commissaries, and soap manufacturers. Revenue realized by surcharging is substantial. (Hancuff-Texas)
W70-06072

STREAM POLLUTION (STREAM POLLUTION CONTROL BOARD).

Tenn Code Ann secs 70-301 thru 70-323 (1956), as amended, (Supp 1970).

Descriptors: *Tennessee, *Water pollution control, *Water pollution, *Pollution abatement, Stream improvement, Legislation, Navigable waters, Streams, Sewage, Sewage disposal, Cities, Wastes, Sewage treatment, Industrial wastes, Municipal wastes, Water pollution treatment, Water quality, Public health, Pollution, Water resources development, Interstate rivers, Administration, Administrative agencies, Permits, Legal aspects.

The Tennessee Stream Pollution Control Board is created and provisions regarding membership, compensation and meetings are set forth. The Department of Public Health is the administrative agent for the Board. The Board's duties are to: (1) supervise the administration and enforcement of all laws relating to pollution; (2) establish standards of water quality and general policies of permissible pollution; (3) issue permits for the discharge of sewage and wastes; (4) issue special orders directing persons responsible for pollution, except governmental bodies without funds, to conduct research and submit plans for pollution control; (5) conduct surveys respecting the pollution of streams; (6) determine location of lakes for purposes of soil and water conservation, recreation, and the propagation of fish; and (7) take all appropriate steps to prevent pollution contrary to the public interest, or to established standards and policies. The Governor may negotiate with other states to prevent and control pollution of streams having their source in other states. Sewage, industrial wastes and pollution are defined. (Casey-Florida)
W70-06076

TOM SAWYER MOTOR INNS, INC. V CHEMUNG COUNTY SEWER DISTRICT NO 1 (NUISANCE CAUSED BY SEWAGE TREATMENT PLANT).
305 TSUSPENDED SOLIDS AND BOD over and above 'normal sewage'. Results of pilot studies using new techniques and description of several unique waste problems, sampling methods, and equipment used are included. Several industries requiring pre-treatment were described in detail with regard to their particular problem. These wastes were industrial laundries, metal platers, acid wastes, paints and varnishes, commissaries, and soap manufacturers. Revenue realized by surcharging is substantial. (Hancuff-Texas)
W70-06072

STREAM POLLUTION (STREAM POLLUTION CONTROL BOARD).

Tenn Code Ann secs 70-301 thru 70-323 (1956), as amended, (Supp 1970).

Descriptors: *Tennessee, *Water pollution control, *Water pollution, *Pollution abatement, Stream improvement, Legislation, Navigable waters, Streams, Sewage, Sewage disposal, Cities, Wastes, Sewage treatment, Industrial wastes, Municipal wastes, Water pollution treatment, Water quality, Public health, Pollution, Water resources development, Interstate rivers, Administration, Administrative agencies, Permits, Legal aspects.

The Tennessee Stream Pollution Control Board is created and provisions regarding membership, compensation and meetings are set forth. The Department of Public Health is the administrative agent for the Board. The Board's duties are to: (1) supervise the administration and enforcement of all laws relating to pollution; (2) establish standards of water quality and general policies of permissible pollution; (3) issue permits for the discharge of sewage and wastes; (4) issue special orders directing persons responsible for pollution, except governmental bodies without funds, to conduct research and submit plans for pollution control; (5) conduct surveys respecting the pollution of streams; (6) determine location of lakes for purposes of soil and water conservation, recreation, and the propagation of fish; and (7) take all appropriate steps to prevent pollution contrary to the public interest, or to established standards and policies. The Governor may negotiate with other states to prevent and control pollution of streams having their source in other states. Sewage, industrial wastes and pollution are defined. (Casey-Florida)
W70-06076

TOM SAWYER MOTOR INNS, INC. V CHEMUNG COUNTY SEWER DISTRICT NO 1 (NUISANCE CAUSED BY SEWAGE TREATMENT PLANT).
305 N Y S 2d 408-413 (1969).

Descriptors: *New York, *Sewage districts, *Treatment facilities, *Damages, Administrative agencies, Water pollution control, Water pollution treatment, Local governments, Sewage treatment, Legislation, Damages, Remedies, Administration, Judicial decisions, Legal aspects.

Plaintiff sued to enjoin an alleged nuisance arising out of the operation of defendant's sewage treatment plant. The court held that the legislation pursuant to which defendant sewer district was established authorized the creation of sewer boards only as administrative arms of the county, and not as separate and independent government units. Therefore, the sewer district could not be sued, and the county itself was the party who was liable. However, the proof as regarded the quantum of damages was insufficient and the case was remanded for a new trial on the issue of damages. (Caldwell-Florida)
W70-06091

THIRD CLASS CITIES (SEWAGE SYSTEMS).
Mo Ann Stat secs 88.540 thru 88.560 (1952).

Descriptors: *Missouri, *Cities, *Drains, *Drainage systems, Sewers, Public health, City planning, Municipal wastes, Treatment facilities, Urbanization, Sanitary engineering, Drainage programs, Drainage engineering, Water management (Applied), Engineering structures, Sewage disposal, Environmental sanitation, Legislation, Legal aspects, Utilities, Drainage, Sewage districts.

The acting municipal authorities of a third class city may, by ordinance, provide drains, sewers and all necessary plants for the disposal of sewage. Third class cities may accept and acquire, by gift, devise, purchase or condemnation, the rights-of-way for drains or sewers, the necessary land for the erection and maintenance of all necessary disposal plants, and the use of natural watercourses of drainage for public drainage and sewer purposes of such city. Before authorizing or constructing sewers or drains, the third class city subdivides its territory into two or more sewer districts. A general

sewer system consists of four classes of sewers: public, district, joint district, and private. Public sewers are established along the principal courses of drainage. District sewers connect with the public sewers, other district sewers, or the natural course of drainage and may be constructed with the main branch or discharge pipe wholly within or beyond the district boundary. Joint sewers are constructed when it is necessary that a sewer be constructed in any part of the city containing two or more sewer districts. The third class city incurs no expense in the construction, repairing or cleaning of private sewers. No public sewer is to be constructed through private property when it is practicable to construct it along or through a street or other public highway. (Powell-Florida)
W70-06092

PHYSICAL AND ECONOMIC FACTORS ASSOCIATED WITH THE ESTABLISHMENT OF STREAM WATER QUALITY STANDARDS, VOLUME I,
Iowa State Univ., Ames. Engineering Research Inst.
For primary bibliographic entry see Field 05B.
W70-06094

THE DELAWARE VALLEY ENVIRONMENT: STATUS AND PROSPECTS.
Greater Philadelphia Chamber of Commerce, Pa.; and University City Science Center and Inst., Philadelphia, Pa.
For primary bibliographic entry see Field 06G.
W70-06101

UNITED STATES V INTERLAKE STEEL CORP (GOVERNMENT ACTION TO ABATE POLLUTION).

297 F Supp 912-917 (N D Ill 1969).

Descriptors: *Illinois, *Rivers and Harbors Act, *Federal government, *Water pollution control, Judicial decisions, Legislation, Rivers, Legal aspects, Water pollution treatment, Pollution abatement, Pollutants, Industrial wastes, Oily waters, Oil wastes, Public health, State governments, Treatment facilities, Water Quality Act.

The United States attorney charged defendant steel corporation with discharging iron particles and an oily substance into The Little Calumet River in violation of secs 13 of The Rivers and Harbors Act of 1899. Defendants made a motion to dismiss the information on the grounds that it was fatally defective: (1) because it failed to allege that the prosecution was undertaken at the request of on officer authorized to do so under secs 17 of the Act; (2) that it failed to allege that the defendant willfully violated the Act; and that (3) there had been no crime committed against the United States. As to (1) above the appellate court held that where the information is not given by an authorized officer under the Act, the right and duty of the federal prosecuting officer to initiate proceedings in the manner usual to criminal cases is not affected. As to (2) above, the court held that the Act does not require any element of scienter to be shown for conviction of a substantive offense in this case. The third allegation failed also in that the Water Quality Act of 1965 does not supercede the provisions of the Rivers and Harbors Act under which the prosecution was brought. Motion to dismiss the information was denied. (Barnett-Florida)
W70-06107

MICROBIOLOGICAL FACTOR IN ACID MINE DRAINAGE FORMATION: A PILOT PLANT STUDY,
Carnegie-Mellon Univ., Pittsburgh, Pa.
Robert A. Baker, and Albert G. Wilshire.
Environmental Science and Technology, Vol 4, No 5, p 401-407, May 1970. 7 p, 1 fig, 5 tab, 14 ref.

Descriptors: *Acid mine water, *Iron bacteria, *Sulfur bacteria, *Water chemistry, *Water pollution sources, Water quality, Ferrobacillus, Thiobacillus ferrooxidans, Aquatic bacteria, Oxidation, Pyrite, Iron compounds, Hydrolysis, Microbiology, Aerobic bacteria, Anaerobic bacteria, Aerobic conditions, Anaerobic conditions.
Identifiers: *Acid mine water microbiology.

The role of chemoautotrophic organisms (Ferrobacillus ferrooxidans, Ferrobacillus sulfooxidans, Thiobacillus thiooxidans) in the formation of acid mine drainage from pyritic materials associated with coal mining has been studied by use of pilot plant reactors. Equilibria were achieved under conditions of aeration or nonaeration and biological seeding or nonseeding at specified hydraulic flow rates. These organisms accelerate oxidation of ferrous iron and sulfide but do not alter the pyritic dissolution rate. In the absence of organisms, effluent ferrous content is greater under aerobic than anaerobic conditions. Ferric content is negligible. Oxygen exclusion does not prevent pyritic dissolution. Under dynamic conditions a steady-state ferrous and sulfide release occurs. Mine sealing practices to eliminate air entry may reduce but will not prevent acid release. Despite an acidic environment, if organic carbon is present, heterotrophic organisms may develop in the aerated systems, and may affect autotrophic metabolism. (Knapp-USGS)
W70-06128

GUIDELINES FOR INVESTIGATIONS INTO THE QUALITY ASPECTS OF WATER RESOURCES RESEARCH,
California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 06B.
W70-06179

ORGANIC MATTER AND FINISHED WATER QUALITY,
East Bay Municipal Utility District, Oakland, Calif.
J. J. Connors, and R. B. Baker.
Journal American Water Works Association, Vol 61, No 3, p 107-113, Mar 1969. 7p, 10 ref, 2 tab, 6 graphs.

Descriptors: *Organic matter, *Pollutant identification, *Water quality control, Surface waters, Analytical techniques, Indicators, Pollutants, Water pollution, Water pollution sources, Wastes, Water pollution control, Organic loading, Biochemical oxygen demand, Organic compounds, Organic wastes, Sewage, Water properties, Potable water, Distribution systems, Reservoirs, Reservoir operation, Reservoir storage, Water quality, Organoleptic properties.
Identifiers: Impaired water quality.

Water quality deterioration can occur because of an accumulation of organic matter after water treatment. This study attempts to establish a basis for the management of a surface supply so as to minimize the overall organic content of the supply. Tests for organic matter levels include: (1) biochemical oxygen demand; (2) chemical oxygen demand; and (3) total organic carbon. There are several points of control of organic matter: (1) the watershed; (2) impoundment; (3) the treatment plant; and (4) the distribution system. Discussions of the results obtained in several treatment systems are analyzed, including the East Bay Municipal Utility District in Oakland, California. It is concluded that: (1) significant differences in amounts of organic matter can occur in similar reservoirs; (2) treatment of organic matter by copper sulfate may be fruitless in some reservoirs; (3) the algal biomass is a minor contributor to the total organic matter present; (4) the total organic load is sometimes established by the character of runoff; (5) organic removals by filtration are slight compared with those by coagulation and sedimentation; and (6) the chemical oxygen demand test can be made to yield good precision with potable waters. (Dye-Florida)
W70-06192

RAW WATER QUALITY CRITERIA FOR PUBLIC SUPPLIES.
For primary bibliographic entry see Field 05F.
W70-06193

PUBLIC RELATIONS, LAW, ENVIRONMENTAL POLLUTION,
Cleveland State Univ., Ohio.
Barbara L. Schoonover, and David J. Sherriff.
Cleveland State Law Review, Vol 18, No 3, p 467-472, Sept 1969. 6 p, 16 ref.

Descriptors: *Social change, *Attitudes, *Pollution abatement, *Environment, Decision making, Social aspects, Social needs, Social participation, Psychological aspects, Behavior, Motivation, Air pollution, Water pollution, Political aspects, Political constraints, Governments, Legal aspects, Legislation, Clean air act, Jurisdiction.
Identifiers: *Public relations.

The relationship between public relations and the law in efforts to control environmental pollution is discussed. Public relations can complement the law by creating an atmosphere in which the law can better perform its function of protecting the people. Various air and water pollution laws are cited and reasons given why they are inadequately enforced. The most important reason is the lack of general public interest. Public relations about law and pollution can make the people aware of the extent and urgency of the problem. The Cleveland experience with public relations and advertising to fight pollution is mentioned. Public relations activity to change laws should be undertaken on a national scale. In addition, local campaigns should be conducted in the major pollution regions to show that pollution statutes need change and stricter enforcement. (Cuevas-Florida)
W70-06200

MAINE LEGISLATIVE RESEARCH COMMISSION: SUBCOMMITTEE REPORT AND PROPOSED LEGISLATION (OIL DISCHARGE PREVENTION AND POLLUTION CONTROL).

Maine Legislative Research Comm, Pub no 104-24, 104th Legislature, 1st Special Sess 1-27 (Jan 1970).

Descriptors: *Maine, *Oil industry, *State governments, *Legislation, Storage tanks, Oil wastes, Distillation, Water pollution sources, Oily water, Pipelines, Shore protection, Harbors, Transportation, Water pollution control, Pollution abatement, Storage tanks, Estuaries, Coasts, Beaches, Public lands, Legal aspects, Administrative agencies, Oil costs, Cost repayment, Regulation.
Identifiers: *Oil pollution, *Oil spills.

Within three years Maine will face a 300 percent increase in oil tonnage moving through her waters. Citing statistics on past oil spills and the problems of transporting oil by ship, the legislative Subcommittee charged with studying coastal conveyance of petroleum products through Maine herein proposes legislation to regulate oil transportation activities. The proposed act establishes an Environmental Improvement Commission empowered to adopt and enforce regulations for the prevention of discharge or spillage of oil in Maine waters. The Commission may set out operating instructions for oil terminal facilities, establish procedures for reporting discharges, prescribe oil removal methods, and establish control districts. The Governor of Maine may declare a state of emergency and is authorized to cooperate with federal authorities when serious oil spills occur. The Maine Coastal Protection Fund is proposed to finance regulatory and clean-up activities. Violators of the Commission's regulations must pay fines to the Fund and also must pay third-party damages. Violators must also pay oil removal costs when the state undertakes the removal of spilled oil. (Hubener-Florida)
W70-06204

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN.

U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2 (1969).

Descriptors: *Lake Michigan, *Water pollution control, *State governments, *Federal government, Governments, Water pollution, Thermal pollution, Pollution abatement, Standards, Water conservation, Water pollution treatment, Water pollution sources, Oil wastes, Domestic wastes, Pesticide residues, Industrial wastes, Sediments, Radioactive wastes, Ships, Nuclear powerplants, Monitoring, Fishkill, Area redevelopment, Planning, Regulation.

Reports are given by states and government agencies as to steps taken to abate pollution in Lake Michigan pursuant to recommendations established in prior conferences. The Wisconsin report lists the extent of compliance with each of the recommendations directed at the states. The Department of Agriculture report outlines what is being done to reduce sediment pollution. A report is made on discharges from federal installations, and proposed legislation for uniform regulations to control watercraft wastes is submitted. The extent of thermal and radiation pollution from nuclear powerplants is outlined with existing regulations that are designed to control it. A report is made on the extent of pollution from insecticides with recommendations for control. A monitoring program is outlined that obtains data useful in identifying pollutants in Lake Michigan and its tributaries. Reports are made on plans to control pollution from oil spills and from alewife die-offs in the Lake. A summary of the proceedings is made by the conferees. (See also W70-06206 thru W70-06209). (Douberley-Florida)
W70-06205

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (WISCONSIN PROGRESS REPORTS).
U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2, p 365-462, 97 p, (1969).

Descriptors: *Wisconsin, *Water resource development, *Water pollution control, *Standards, Lake Michigan, Water resources, Surface waters, Water conservation, Water management (Applied), Water policy, Water quality, Water pollution, Water treatment, Administration, Area redevelopment, Planning, State governments, Sewage, Effluents, Disinfection, Treatment, Zoning, Land use, Landfills, Phosphorus, Pollution abatement, Administrative agencies.

The Wisconsin Department of Natural Resources was created to combine both pollution and resource management functions in one administrative body. Water quality standards have been extended to cover both interstate and intrastate waters, requiring secondary treatment of sewage and wastes as well as disinfection of effluents. Counties are required to zone all shore lands in unincorporated areas to protect against unwise development. Dumps and sanitary landfills are regulated by state licensing procedures. It is suggested that the Conference recommendation that municipalities achieve an eighty percent reduction in phosphorus be considered in light of the total phosphorus load in each state rather than applied to each individual municipality. Larger cities can attain greater than eighty percent, while smaller municipalities cannot feasibly treat phosphorus effluents. Statutes prohibit the dumping of polluted materials into any waters of the state. (See W70-06205). (Douberley-Florida)
W70-06206

CONFERENCE POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (USDA PROGRAMS TO PREVENT AGRICULTURAL POLLUTION).
U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2, p 463-503, 40 p (1969).

Descriptors: *Erosion control, *Administrative agencies, *Federal government, *Soil conservation, Lake Michigan, Water pollution control, Administration, Water pollution, Planning, Pollution abatement, Farm management, Agricultural engineering, Contour farming, Drainage practices, Land use, Land management, Soil management, Land, Farms, Rural areas, Small watersheds, Sedimentation, Silting, Bank erosion, Erosion, Sediment control, Water conservation.

Agricultural lands supply the greatest amount of sediment carried by streams because of the large area involved, but much of sediment also comes from urban areas under construction, roadsides, surface mining, sand and gravel pits, and streambank erosion. The Department of Agriculture aids individuals, communities and government agencies in preserving soil and water resources through conservation. The Soil Conservation Service (SCS), through Soil Conservation Districts, assists conservationists and land users in planning and making decisions about proper land use. The Agricultural Stabilization and Conservation Service provides cost-sharing and technical assistance in establishing conservation practices. The Cropland Adjustment Program diverts land to uses that control air and water pollution. The Farmers Home Administration administers loans and grants for water supply and waste disposal systems, recreation facilities and conservation measures. Under the Small Watershed Program, SCS gives technical and financial aid to local watershed projects. SCS also provides leadership for resource conservation and development projects, including technical assistance and credit to finance local improvements. Research programs provide valuable data on soils, plants and water quality. (See W70-06205). (Douberley-Florida)
W70-06207

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (NUCLEAR POWERPLANT WASTE DISPOSAL).
U S Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan and Wisconsin, vol 2, p 537-691, 154 p, (1969).

Descriptors: *Lake Michigan, *Nuclear powerplants, *Nuclear wastes, *Thermal pollution, Water pollution, Water pollution control, Water quality, Planning, Facilities, Radiation, Disposal, Nuclear engineering, Nuclear reactors, Radioactive waste disposal, Water pollution sources, Heated water, Radioactivity effects, Temperature, Pollution abatement, Regulation, Municipal water, Recreation, Aquatic life, Mixing, Dispersion, Standards.

Nuclear power plant wastes are governed by criteria, standards and regulations set by the states, the Secretary of the Interior and the Atomic Energy Commission (AEC). The states bordering Lake Michigan each provide for maximum temperature limits and reasonable distances for mixing. Radionuclide limits are based on the Public Health Service 1962 Drinking Water Standards. AEC responsibility is limited to radioactive waste disposal and does not extend to thermal pollution. Concentration limits are directed at protecting individuals from exposure to radiation. Recommendations by the Federal Water Pollution Control Administration to the Secretary of the Interior set temperature limits for both recreational and fish life uses. Limits are placed on radionuclides in municipal water sources and in habitats for aquatic life. Applications for AEC nuclear power plant licenses state that radioactive disposal will be in compliance with set standards. Danger from routine plant operations is remote, although there is a need for a plan to coordinate the agencies involved in the event of an accident. Lack of available information makes it difficult to evaluate the adequacy of proposals and regulations concerning the disposal of heated cooling water. Additional data is needed to deal with the problems created by additional power plants in the future. (See W70-06205). (Douberley-Florida)
W70-06208

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN (NATIONAL MULTIAGENCY OIL CONTINGENCY PLAN).
US Dept of Interior, Fed Water Pollution Control Admin, Conference on Pollution of Lake Michigan and Its Tributary Basin, Illinois, Indiana, Michigan, and Wisconsin, vol 2, pp 853-938, 85 p, (1969).

Descriptors: *Water pollution, *Pollution abatement, *Oil, *Project planning, Pollutant identification, Water pollution sources, Water pollution control, Warning systems, Oil wastes, Oily water, Abatement, Federal government, Governments, Planning, Future planning (Projected), Disposal, Legislation, Damages, Accidents, Inter-agency cooperation.
Identifiers: *Oil spills.

In response to a number of disasterous oil spills, the President directed the Secretary of the Interior to prepare multi-agency contingency plans for responding to oil spill emergencies. The plan establishes a national reaction team and provides guidelines for regional plans and reaction teams. Through the National Interagency Committee, the plan coordinates federal, state and local efforts and encourages the development of local capabilities to handle pollution incidents. The plan covers all navigable waters in the United States and areas immediately adjacent that would directly effect navigable waters. The person responsible for the pollution is encouraged to remove the pollution and to mitigate its effects. Direction of efforts on the scene of a pollution incident is under the control of a commander designated by either the Coast Guard or the Department of the Interior. As soon as a spill is discovered, the agencies concerned initiate containment actions. The area is cleaned up, the environment is restored to its pre-spill condition, and the pollutants are disposed of. Actions are taken to recover damages for injury to federal property and to enforce applicable laws. The applicable federal laws are listed briefly. (See W70-06205) (Douberley-Florida)
W70-06209

MECHANICAL REMOVAL OF ORGANIC PRODUCTION FROM WATERWAYS,
Wisconsin Univ., Madison; and Corps of Engineers, New Orleans, La.
D. F. Livermore, and W. E. Wunderlich.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, p 494-519, 1969. 7 fig, 62 ref.

Descriptors: *Eutrophication, *Water pollution control, *Productivity, Texas, Wisconsin, New York, Florida, Louisiana, Lakes, Nutrients, Phosphorus compounds, Water hyacinth, Water quality control, Harvesting, Maryland, Nitrogen compounds.
Identifiers: *Mechanical control, *Hydrosphere, Najas, Vallisneria, Eel grass, Potamogeton, Trapa natans, Africa, Alternathera, Eichhornia, Salvinia, Nile River, Rhodesia, Myriophyllum, Milfoil, US Army Corps of Engineers, Alligator weeds, Chesapeake Bay, Water chestnut, Potomac River, Sassafrass River (Md), Redhead-grass, Elodea, Anacharis, Chatauqua Lake (NY), Coontail.

Among highly undesirable effects of excessive eutrophication is overproduction of plants, both planktonic and macrophytic. Problems range in magnitude from minor reductions in recreational and esthetic quality to almost complete loss of utility for many purposes. Control of plant growth is accomplished by physical, chemical, biological, and mechanical means. Chemical control with algicides and herbicides is widely employed because it is easy, effective, and inexpensive; chemicals are probably the only method of controlling planktonic algal blooms in current use. Chemical methods are disadvantageous because they are portentially toxic to fauna, and their residual effects on ecosystems are unpredictable and poorly understood. Mechanical harvesting seems most ecologically sound: foreign substances are not introduced into water, nutrients are removed from cycles, lacustrine filling is reduced, biotic disturbances are apparently minimal. Growth of macrophytes is controllable with manual methods: powered cutting and uprooting devices, and larger systems for cutting and collecting. Effective for control of various plants, mechanical devices are described from Louisiana, Chesapeake Bay and tributaries, Florida, New York (city and state), and Wisconsin. Descriptions include equipment, effectiveness, and economics. Recent research in mechanical control is outlined, and potential avenues for further study are suggested. (See W70-03975) (Eichhorn-Wisconsin)
W70-06212

EDUCATING THE PUBLIC IN NATURAL RESOURCES,
Wisconsin Univ., Madison. Dept. of Journalism; and Wisconsin Univ., Madison. Dept. of Wildlife Ecology.
Clay Schoenfeld.
Journal of Soil and Water Conservation, Vol 23, No 6 (4 p reprint), 1968.

Descriptors: *Environment, *Education, Public benefits, Pollution abatement, Conservation, Recreation, Social aspects, Environmental sanitation, Resources.
Identifiers: Public relations, Public responsibility, Public approval, Environmental quality, Resource management

Inasmuch as the most effective use of natural resources is determined by public decisions, attitudes and involvement are the basis of defining and maintaining environmental quality. Good public education, via mass media, are necessary to interpret resource problems in order to resolve conflicting interpretations of what constitutes wise conservation. As the technical and organizational skills of the land conservationist are inferior to the land exploiter, a stream of skills and resources at local and regional levels is required to translate federal intentions and state plans into positive action. We must develop a culture which recognizes man's interdependence with his environment and his responsibility for maintaining it. The public must be taught to weigh alternatives and make rational choices concerning natural resources in order that the experts' ideology are brought to the level of the citizenry in the form of 'environmental' education, which is more comprehensive in describing our efforts to cope with the degradation of our sphere than 'conservation' education--often limited in scope and associated with pressure groups. (Powers-Wisconsin)
W70-06228

AIR POLLUTION AND ATOMIC POWER,
C. K. Viland.
Mines Magazine, Vol 60, No 1, p 17-23, Jan 1970. 5 p.

Descriptors: *Air pollution, *Atmospheric pollution, Electric power, *Electric powerplants, Nuclear energy, *Nuclear powerplants, Pollution abatement, Pollutants, Combustion, Radioisotopes, Nuclear explosions, Radiation hazards, Nuclear reactors, Health.
Identifiers: Air pollution control, Nuclear fuels, Nuclear safety, Fossil fuels, Health protection.

The need for electrical power is increasing faster than the population explosion. Many people fear the construction of a nuclear powerplant in their neighborhood because of association with the atomic bomb. Besides the inherent safety, a greater proportion of nuclear electrical powerplants, with respect to conventional steam plants, will alleviate air pollution. Nuclear plants are essentially free of emissions whereas impurities in the atmosphere from industry and transportation have increased in recent years. Scientists are becoming alarmed about the environmental changes taking place and the rapid rate of change. The article contains condensed material from numerous sources, and may serve a useful purpose in pollution control activities. (USBR)
W70-06259

POLLUTION, LAW, SCIENCE, AND DAMAGE AWARDS,
Thomas M. Schmitz.
Cleveland State Law Review, Vol 18, No 3, p 456-466, Sept 1969. 11 p, 91 ref.

Descriptors: *Remedies, *Damages, *Water pollution control, *Cities, Environmental sanitation, Legal aspects, Pollution abatement, Public health, Standards, Water conservation, Water resources development, Water law, Governments, Remedies, Administration, Legislation, Judicial decisions, Water pollution, Environmental effects, Environment engineering, Water pollution treatment, Nonstructual alternatives.
Identifiers: Nuisance (Public), Nuisance (Private), Injunction.

A historical survey of American courts' approaches to man-created environmental pollution problems is presented. Liability for air and water pollution has been based upon a variety of forms of actions, including negligence, nuisance, and trespass. A nuisance concept has developed in which a distinction has emerged between public and private nuisance. Compensatory and punitive damages are recoverable in law for injuries caused by environmental pollution. Equity will intervene and abate environmental pollution by injunction. Legal and equitable remedies are concurrent and, therefore, environmental pollution may be enjoined even though damages have been assessed. Environmental pollution interfering with the health and well-being of an entire community is a public nuisance which may subject wrongdoers to criminal prosecution. Municipalities are liable for environmental pollution created and maintained by them, even though such pollution may be pursuant to exercising a governmental function. Municipalities possess delegated police powers to abate pollution. Public officials charged with a duty to enforce pollution abatement laws are susceptible to liability for neglect of their official duties. Public pollution abatement laws have been upheld, and the expenditures for pollution controls are not considered unreasonable. Public pollution laws are invalid to the extent that compliance therewith is impossible due to a lack of scientific know-how. However, lack of suitable pollution controls is not a defense to a nuisance action initiated by a private citizen. (Powell-Florida)
W70-06290

POLLUTION CONTROL AND THE FEDERAL POWER COMMISSION,
John A. Carver, Jr.
Natural Resources Lawyer, Vol 1, No 1, p 32-38, Jan 1968. 7 p, 16 ref.

Descriptors: *Administrative agencies, *Water pollution, *Pollution abatement, *Federal government, Air pollution, Federal Power Act, Thermal pollution, Environmental engineering, Public health, Hydroelectric plants, State governments, Hydroelectric project licensing, Permits, Regulation, Water resources development, Legal aspects, Natural gas, Rates, Project planning, Water pollution control.
Identifiers: *Federal Power Commission.

Pollution of air and water is a universal problem. The effectiveness of federal, state, local and private efforts to do something about it is often criticized. The role of the Federal Power Commission is vital in affecting pollution due to its administration of The Federal Power Act and the Natural Gas Act. The Agency's response to the pollution question is an integrated answer due to the mixed character of its institutional ties, being legislatively, executively and judicially enmeshed. This mixture gives to the Agency a bi-partisan character allowing better central planning through its legislative function and giving a broad-spectrum consideration of pollution in its decision-making capacity. The Agency makes a severe impact on air and water pollution through its administrative functions in the licensing of new hydroelectric plants, arbitration of competitive fuel questions, and by interpreting the government's needs for regulated industry. In light of such governmental administrative functions, we must not overlook the individual. The fight against pollution is one that knows no political boundaries and is in need of cooperation from all sectors of government. (Barnett-Florida)
W70-06292

RECENT DEVELOPMENTS IN INTERNATIONAL ENVIRONMENTAL POLLUTION CONTROL,
Frederick J. E. Jordan.
McGill Law Journal, Vol. 15, No 2, p 279-301, June 1969. 23 p, 111 ref.

Descriptors: *Governments, *Air pollution, *Water pollution, *Pollution abatement, Legal aspects, Political aspects, Federal government, Water resources development, International law, Environment, Environmental effects, State governments, Legislation, Social aspects, Environmental sanitation, United States.
Identifiers: Canada, Transboundary water pollution.

The extent and magnitude of water and air pollution in North America are discussed. The national aspects of environmental pollution problems in Canada and the United States are considered. Examples of Canadian-American boundary water pollution incidents are cited. The development of international rules relating to pollution control is generally outlined. The Helsinki Rules, adopted by the International Law Association, which relate to transboundary water pollution are examined. The laws and machinery for dealing with problems of environmental pollution in Canada and the United States are surveyed. It is pointed out that both governments have employed the International Joint Commission, created by the Boundary Waters Treaty, as an advisory agency in water pollution cases. Both states have accepted the Trial Smelter Arbitration case rule dealing with air pollution. In order to combat environmental pollution problems the Canadian and United States governments could amend the Boundary Waters Treaty to extend the water pollution obligations to transboundary air pollution. The International Joint Commission should be vested with jurisdiction over all matters of transboundary water and air pollution in regards to investigations and supervision of recommendations. (Powell-Florida)
W70-06298

CONFERENCE COMMITTEE, NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, HR REP NO 91-765, 91ST CONG, 1ST SESS.

Clean Air and Water News, Vol 2, No 1, p 3-14, Jan 1970. 12 p.

Descriptors: *Legislation, *Environment, *Federal government, *Administrative agencies, Environmental effects, Federal project policy, Ecology, Urbanization, Pollution abatement, Population, En-

vironmental sanitation, Legal aspects, Social aspects, Institutional constraints, Industrial wastes, Political constraints, Political aspects, Government finance, Regulation, Quality control, Administration, Coordination, Public benefits, Public health.

Title I of the National Environmental Policy Act of 1969 declares it to be national policy that the environment be protected and maintained in the midst of urbanization and industrial development. All federal agencies are directed to study and identify methods by which environmental quality may be protected and to conform their regulations, policies, and procedures to the provisions of this Act. Every report or recommendation on federal legislation or other action must include a statement on the environmental impact of such action. Title II establishes the Council on Environmental Quality, which would serve as an advisory and investigatory agency concerned with coordinating the federal government's environmental policy. Differing versions of the Act were passed by the Senate and the House, though the differences were minor in nature. The joint conference committee agreed on provisions reconciling the different versions and recommended passage of the amended bill by both houses. (Caldwell-Florida)
W70-06299

THE MODIFICATION OF A PREDICTIVE RIVER BASIN MODEL,
South Dakota State Univ., Brookings.
Richard P. Covert.
Available from the Clearinghouse as PB-191 537, $3.00 in paper copy, $0.65 in microfiche. Completion Report, April, 1970. 13 p. OWRR Project A-014-SDAK (2).

Descriptors: *Computer model, *River forecasting, *Water level flucuations, Basins, *Water quality, Low flow, Dissolved oxygen, Evaluation, Forcasting.

The computer model of the effect of the geographic and economic aspects of a river basin on the water quantity and quality of the given river that was originally developed at the University of Missouri was modified to accept distributed input and reaction factors and tested against low flow conditions on the Big Sioux River from the Sioux Falls wastewater treatment plant to the community of Klondike, thirty-two miles downstream. The model performed best for low flow conditions than for greater flows, but agreed with other investigators on the location of the point of minimum dissolved oxygen and in half of the trials with the amount of the minimum dissolved oxygen. The application of sensitivity analysis to the model indicated that the model was sensitive to initial flow, initial dissolved oxygen deficit, river temperature, Fair's factor, reach length, and amount of settleable organic waste.
W70-06313

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

DECISION CRITERIA FOR STOCHASTIC HYDROLOGY,
Water Resources Engineers, Inc., Springfield, Va.; and Water Resources Engineers, Inc., Walnut Creek, Calif.
George K. Young, Gerald T. Orlob, and Larry A. Roesner.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7209, p 911-926, April 1970. 16 p, 7 fig, 16 ref, append.

Descriptors: *Decision making, *Systems analysis, *Stochastic processes, *Mathematical models, Water resources development, Synthetic hydrology, Simulation analysis, Statistical models, Statistical methods, Data processing, Economics, Planning.
Identifiers: Stochastic hydrology.

A decision-theoretic plan is presented that provides insight into questions of interest to the system planner about to embark on a study which uses stochastic hydrology. The plan considers and integrates three broad areas: (1) The collection, interpretation, and adjustment of the data bank which is required to iniatiate stochastic modeling; (2) the investigation of existing, and development of new, stochastic hydrology models; and (3) the construction of water resource simulation procedures whose outputs serve as vehicles by which the importance of the other necessary tasks can be determined. The overall plan has component tasks which correspond directly to the design steps of the system planner, emphasizing data management. A scheme for multivariate data fill-in, based on variance reduction criteria, is presented. (Knapp-USGS)
W70-05910

OBJECTIVE DETERMINATION OF SAFETY FACTOR IN RESERVOIR DESIGN,
Geological Survey, Washington, D.C.; Geological Survey, Fort Collins, Colo.; and Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 08A.
W70-06111

DIGITAL MODEL OF ALLUVIAL AQUIFER,
Nova Scotia Dept. of Mines, Halifax; and Geological Survey, Washington, D.C.
Peter C. Trescott, George F. Pinder, and John F. Jones.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7264, p 1115-1128, May 1970. 14 p, 13 fig, 12 ref, append.

Descriptors: *Mathematical models, *Simulation analysis, *Aquifers, *Alluvium, Water supply, Municipal water, Water wells, Drawdown, Water yield, Induced infiltration, Water management (Applied), Digital computers.
Identifiers: Aquifer testing, Pumping tests, Antigonish (Nova Scotia).

The evaluation of an alluvial aquifer as a water supply for the Town of Antigonish, Nova Scotia, has demonstrated the versatility of the digital model as a tool in groundwater development and management. The digital model, which uses an alternating-direction implicit technique to solve the finite-difference approximation of the flow equation, is limited in size only by the available hydrogeologic data, the amount of computer storage, and availability of computer time. The model of the Antigonish aquifer, which is hydraulically connected to a river, was adjusted within the constraints dictated by the geology until the model response to a pumping stress approached the field response. The most critical factor was the river-bed hydraulic conductivity to thickness ratio which governs the drawdown required to induce enough water from the river to sustain well production. The adjusted model was used to predict the effect of establishing a multiple well field designed to meet the town's requirements. (Knapp-USGS)
W70-06130

WHY DO WE NEED CHEMICAL METHODS,
Marine Biological Association of the United Kingdom, Plymouth (England). Lab.
L. H. N. Cooper.
Chemical Environment in the Aquatic Habitat, Golterman, H L and Clymo, R S, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, p 15-23, 1967. 12 ref.

Descriptors: *Chemical analysis, *Planning, Sampling, Iron, Limnology, Oceanography, Meteorology, Geochemistry, Phosphorus compounds, Instrumentation, Research and development, Administration, Water chemistry, Marine fisheries, Nutrients, Phosphates, Silicates, Chromatography, Nitrogen compounds, Cyanophyta, Estuaries, Amino acids, Bioassays, Vitamins, Physiological ecology, Plankton, Carbon cycle, Manganese, Economics.
Identifiers: Research ships, Iodine, Mass spectometry, Physicochemical techniques, Greenhouse effect, Organic phosphorus, Chemical limnology, Chemical oceanography, Trichodesmium, India, Bay of Bengal, Vellar estuary (India), Exocrines, Thiamin, Biotin, Growth factors, Fisheries research.

Increasingly, research must be justifiable on bases of practical and economic ends, including those of public health and welfare. Hydrochemical techniques are required for solution of practical problems in fisheries research, meteorology, and geochemistry. New methods and better understanding of old methods are needed, particularly regarding improvement of ship-borne instrumentation and facilities. Improved understanding of the ecological role of micronutrients and exocrines will necessitate increased employment of sensitive bioassays. The problems of organic chemical oceanography are diverse and complex, and will likely require adaptation of costly instrumentation, including chromatography, mass spectrometry, and nuclear magnetic resonance spectroscopy. In meteorology, great importance attaches to the greenhouse effect, where physicochemical methods must be brought to bear in study of exchange of carbon dioxide at the hydrosphere-atmosphere interface. Similarly, physical understanding must be sought of kinetics and equilibria of iron, because of its nutrient status; iodine, in its role in public health; and manganese, because of economic considerations. Solutions to such problems raise seemingly insoluble administrative problems in connection with staffing, financing, and provision of adequate facilities to promote effective use of researchers' time. (See W70-04821) (Eichhorn-Wisconsin)
W70-06215

THE MODIFICATION OF A PREDICTIVE RIVER BASIN MODEL,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 05G.
W70-06313

6B. Evaluation Process

KETHIKAN GATEWAY BOROUGH: WATER AND SEWAGE SURVEY.
Alaska State Housing Authority, Anchorage.
For primary bibliographic entry see Field 05C.
W70-06033

PREDICTING FUTURE GROWTH OF ORGANIC POLLUTION IN METROPOLITAN AREA RIVERS,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
M. Marcus, and W. Whipple, Jr.
Available from the Clearinghouse as PB-191 218, $3.00 in paper copy, $0.65 in microfiche. Partial Completion Report. OWRR Project B-002-NJ, Feb. 1970. 29 p.

Descriptors: *Statistical methods, *Population, *Growth rates, *Water pollution, *Biochemical oxygen demand, *Mass water quality, Domestic wastes, Industrial wastes, Regression analysis.
Identifiers: BOD Mass Balance Analysis.

This research report analyzes quantitative relationships between (a) growth of gross man-made pollution entering streams and (b) the growth of population and of various types of industrial activity. Three river basins in the rapidly growing New York-Philadelphia area were studied over an eleven-year period. Statistical correlation indicates that gross water pollution (prior to treatment) is growing with population, but more slowly, the growth rate being about 55% of the population growth rate. Consideration of various industrial in-

dices fails to improve the correlation. If relationships continue for 20 years for the Passaic River Basin as they were for the period 1957-67, the gross man-made pollution would increase by 85%. The relevance of such projections to water quality control planning appears obvious. (Whipple-Rutgers)
W70-06036

INCORPORATION OF AGRICULTURAL RISK INTO WATER RESOURCES PLANNING MODELS,
Texas A and M Univ., College Station. Inst. of Statistics; and Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 03F.
W70-06100

GUIDELINES FOR INVESTIGATIONS INTO THE QUALITY ASPECTS OF WATER RESOURCES RESEARCH,
California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.
Jack Edward McKee.
Office of Water Resources Research Report, January 1966. 22 p, 1 fig.

Descriptors: *Water resources research act, *Research and development, *Water quality, Research facilities, Laboratories, Grants, Planning, Testing.
Identifiers: Water resources research, Office of Water Resources Research.

A brief background of investigations into the water-quality aspects of water-resources research is presented. The roles of various federal and other agencies in the area of water quality and the problems that appear to be in most urgent need of research by water-resources personnel are described. Measures for improving the character of, and potential for, future research are suggested. (Knapp-USGS)
W70-06179

FLOOD WARNING BENEFIT EVALUATION - SUSQUEHANNA RIVER BASIN (URBAN RESIDENCES),
Weather Bureau, Silver Spring, Md. Office of Hydrology.
For primary bibliographic entry see Field 06F.
W70-06182

PLANNING PROGRAM (1969).
Denver Board of Water Commissioners, Colo.

Board of Water Commissioners, Denver, Colorado, May 1969. 47 p, 9 fig, 12 tab.

Descriptors: *Planning, *Water resource development, *Water supply, *Future planning, *Long-term planning, *Financing, Construction, Capital costs, Construction costs.
Identifiers: *Denver Board of Water Commissioners, *Colorado River, Denver water supply program.

This water facilities planning report includes recommendations for construction and methods of financing the $749,000,000 capital improvements program proposed for implementation during the forty-year period 1969-2008. The report parallels a 1969 capital improvement program report by Black and Veatch which covered the period 1969-1980. Proposed facility expansion and new facility construction is based upon an estimated three-fold increase in water requirements, from 216,000 acre feet in 1969 to 594,000 acre feet in 2008. The appropriation of new water supplies to meet this demand must come from the Colorado River system and from transmountain water sources. One 60 mgd addition at Moffat Treatment Plant, followed at 4 to 8 year intervals by five additional 100 mgd units are proposed to meet water treatment requirements. Major water transmission and storage facilities are scheduled for construction to meet the added water demands and for integration of the Moffat and South Platte supplies for both load-shifting and system protection in case of major outage. Three alternative financing plans are deemed feasible. The plan recommended entails the use of $107,000,000 from operating revenues, and financing of $642,000,000 for the capital improvements. (Poertner-Chicago)
W70 06188

AMERICA'S DEPARTMENT OF NATURAL RESOURCES: THE UNITED STATES DEPARTMENT OF THE INTERIOR.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402-Price 40 cents. U S Dept Interior Report, 1969. 45 p.

Descriptors: *Federal project policy, *Federal government, *Water resources development, *Administrative agencies, Area redevelopment, Coordination, Programs, United States, Federal reclamation law, Federal reservations, Hydroelectric plants, Fish conservation, Fish management, Multiple-purpose projects, Geological surveys, Irrigation, Flood control, Water supply, Recreation, Water quality control, Desalination, Desalination plants, Desalination processes.
Identifiers: *Department of the Interior.

The Department of the Interior is the principal federal agency dealing with the nation's natural resources. Several bureaus within the Department carry out programs directly related to water conservation and use. The Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries conduct programs for the development of recreational and commercial fish resources. The Bureau of Outdoor Recreation conducts outdoor recreation planning for all federal water projects. The Geological Survey conducts studies of the quantity and quality of water throughout the country and compiles these studies into a national water data system. Several regional power agencies generate, transport, and market hydroelectric power from federally constructed water, flood and navigation projects. In 17 western states the Bureau of Reclamation coordinates federal projects whose purposes include: irrigation, flood control, navigation improvement, hydropower generation, municipal and industrial water supply, recreation, fish conservation, and water quality improvement. The Water Pollution Control Administration and the Office of Saline Water handle all activities dealing with water quality management and desalination of salt and brackish water. The Office of Water Resources Research sponsors research and training in the fields of water and resources which affect water. (Dearing-Florida)
W70-06197

CONSIDERATION OF ANTICIPATORY USES IN DECISIONS ON COASTAL DEVELOPMENT,
Rhode Island Univ., Providence. Dept. of Political Science.
For primary bibliographic entry see Field 06E.
W70-06201

WEATHER MODIFICATION AS AN UNCERTAIN INNOVATION,
Fred L. Strodtbeck.
Soc Sci Environ Conf Present Potential Contrib Soc Sci Res Policy Formulation Qual Phys Environ, p 103-124, Univ Colo, Boulder, Jan 31-Feb 2, 1967. 22 p, 1 tab, 11 ref, disc.

Descriptors: *Weather modification, *Social aspects, *Attitudes, *Social impact, Research and development, *Public opinion, Social values, Experimental data, South Dakota, Weather, Atmosphere, Legal aspects, Environment.
Identifiers: Hailswath Project (S Dak), Hermosa (S Dak), Research scientists, Interviews.

Acceleration of research on the physical science aspects of weather modification research suggests that attention should now be directed simultaneously to the social aspects. Public response to the problems of weather modification and the willingness of a community to permit weather modification experimentation must be studied. Local protest can become an insurmountable block to weather modification experimentation. Ranchers in Hermosa, S Dak, site of the Hailswath Project, were interviewed on the subject of weather modification; results of the survey are discussed. (USBR)
W70-06258

THE NERVOUS AFFAIR BETWEEN BEHAVIOR SCIENTISTS AND DESIGNERS,
City Univ. of New York.
Gary H. Winkel.
Psychology Today, Vol 3, No 10, p 31-35, 75, Mar 1970. 6 p

Descriptors: *Planning, Environment, *Environmental effects, Ecology, Social adjustment, Social aspects, *Social participation, Social values, *Human behavior, Project planning, Design, Urbanization, Urban renewal, Urban sociology, Housing, Recreation, Recreation facilities, Relocation, Architecture, Behavior (Psychology).
Identifiers: Social acceptance, Wilderness areas.

Solutions to environmental crises are not found easily in our complex society. The concept of participatory planning is presented as a step forward in solving the social and environmental problems confronting man, as in planning for urban renewal, housing projects, relocation of people in ghettos and disaster-prone areas, and recreational uses of wilderness areas. Some planners have argued that planning and design were not only a matter of aesthetics, but that the needs and preferences of the people who might suffer the consequences of design must also be considered. Interest has arisen from the feeling that environmental planning has been too authoritarian. Decisions have been imposed from above instead of growing out of the participation and consent of those affected by the decision. Participatory planning is based on the notion that those who live in a given place are in the best position to know their needs and requirements. The planner serves as a technician who listens to the community and explains the implications associated with the selection of various environmental alternatives, but ultimate choice rests with the community itself. (USBR)
W70-06263

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

RIDGEWOOD COUNTRY CLUB V BOROUGH OF PARAMUS (UNREASONABLE ASSESSMENT FOR SEWERS).

259 A2d 218-223 (NJ 1969).

Descriptors: *New Jersey, *Cost-benefit ratio, *Assessments, *Sewers, Judicial decisions, Cost allocation, Cities, Local governments, Cost-benefit analysis, Cost-benefit theory, Benefits, Project planning, Laterals, Real property, Land use, Land classification, Zoning, Sewage disposal, Taxes, Legal aspects.

Defendant municipality levied a special assessment of $154,333 upon plaintiff for benefits from a sanitary sewer line placed along plaintiff's 260-acre golf course. Without using a discernible formula, acreage was assessed at $1200 per acre, and other parcels were assessed on a modified front footage basis. Plaintiff contested the assessment on the grounds that it received no benefits from the improvement and that the assessment was excessive. The trial court reduced the assessment to $15,000 and the appellate court affirmed. Upon this appeal, the supreme court found that plaintiff's land

received a benefit from the sewer even though the golf course had no immediate use for it. Its value was increased for residential purposes, which was a legitimate use of the land. However, the court found that the assessment was unreasonable and excessive. It bore no relationship to the front foot formula employed for other parcels and did not consider the future cost of laterals necessary to connect to the trunk line. The case was remanded for the municipality to arrive at an assessment that bore the same relationship to the net benefits to the property as that borne by other properties. (Douberley-Florida)
W70-05964

MILESTONE V WASHINGTON SUBURBAN SANITARY COMM'N (SUBSEQUENT BENEFIT ASSESSMENTS ON THE SAME TRACT OF LAND).
260 A 2d 43-57 (Ct App Md 1969).

Descriptors: *Assessments, *Maryland, *Sewers, Real property, Judicial decisions, Benefits, Project benefits, Local governments, Cities, Financing, Boundaries (Property), Legal aspects, Administrative agencies.
Identifiers: Benefit charges, Frontage assessments.

Plaintiff landowner was assessed for sewer benefits according to the frontage of his property which actually abutted the sewer line. He paid the entire amount that the Sanitary Commission computed as redeeming the benefit charges in full. Subsequently, a portion of the tract was developed by the erection of apartment buildings which were connected to the existing sewer. The land was reclassified according to an amendment to the statute, and an additional benefit charge was imposed. Plaintiff complained on the grounds that the benefit charges for the entire tract had already been redeemed. The court held that the Commission was justified in treating the tract as more than one lot under the then applicable law. The assessment was proper. The only assessment made previously was in reference to the frontage abutting the sewer, and the remainder of the tract had made no contribution to the sewer installation. The dissent would have treated the benefit charges as redeemed, since it was the intention of both parties to remove the lien or encumbrance attached to the charges. Also, the changed law authorizing the reclassification should not have been applied retroactively. (Douberley-Florida)
W70-06019

EXETER REALTY CORP V TOWN OF BEDFORD (ENTRANCE FEE FOR CONNECTION TO SEWAGE FACILITIES UPHELD).

252 NE2d 885-889 (Mass 1969).

Descriptors: *Local governments, *Massachusetts, *Sewers, *Sewage disposal, Cost allocation, Legislation, Construction costs, Costs, Cost sharing, Cost repayment, Government finance, Taxes, Sewage, Judicial decisions, Legal aspects, Water law, Financing, Assessments, Rates.

Plaintiff land developer subdivided and constructed dwellings on property within defendant town. Defendant sought to levy an entrance fee on plaintiff for the connection of sewage facilities, constructed within plaintiff's subdivision, to the town sewage system. Statutes authorized towns to provide for construction and maintenance of sewers by assessment of entry fees as determined by the town. Plaintiff contended that defendant exceeded its authority by levying the connection fee. The town had assessed at reduced rates for entry of previously constructed facilities. The court held that defendant's assessment was reasonable and within its authority under statute. The assessment was reasonably designed to defray the cost of construction and maintenance of facilities beneficial to plaintiff. (Dye-Florida)
W70-06023

THE COST OF SEWAGE TREATMENT,
Newcastle-upon-Tyne Univ. (England).
For primary bibliographic entry see Field 05D.
W70-06061

COMPUTER ANALYSIS OF ENGINEERING ECONOMIC STUDIES,
Clinton Bogert Associates, Fort Lee, N.J.
Ivan L. Bogert.
Journal Water Pollution Control Federation, Vol 50, No 12, p 2033-2035, Dec 1968. 2 ref.

Descriptors: *Computers, *Costs, Analysis, Design, Digital computers, Plants, Programs, Sewers.
Identifiers: *Bergen County (NJ).

Computers have been used for the financial aspects of projects reports for the Bergen County Sewer Authority, New Jersey. The reports, required by law, must include 40 year estimates of domestic and industrial flows, required plant and sewer enlargement dates, capital and annual financial costs of present system and all future enlargements, and annual plant and system operating costs and rates applicable to the various participants both with and without the project being studied. Computer programming permits reduced professional time, rapid production of reports, more thorough study of possible variations in direct printing of calculations from computer sheets. (Hancuff-Texas)
W70-06080

OPERATING EXPERIENCES AT SWINDON, 1962-67,
Swindon (England).
For primary bibliographic entry see Field 05D.
W70-06081

SURVEY OF WASTE WATER RATES AND CHARGES,
Sewer Dept., Lafayette, La. Utilities System.
For primary bibliographic entry see Field 05D.
W70-06086

6D. Water Demand

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, SUMMARY REPORT.
Denver Board of Water Commissioners, Colo.

Denver Regional Council of Governments, July 1969. 26 p, 7 fig, 6 tab. HUD Project No. Colo. P-62.

Descriptors: *Water resources development, *Water supply, *Water demand, *Water shortage, *Planning, *Future planning, Construction, Construction costs, Long-term planning, Financing, Capital costs, Design criteria, Water conveyance.
Identifiers: *Denver Board of Water Commissioners, *Denver water supply program, *Denver Regional Council of Governments.

The water resources and requirements of the Denver Metropolitan Area to the year 2010 were investigated. The investigation encompassed a 'primary study area' (Denver and the urbanized portions of Adams, Arapahoe, Boulder and Jefferson Counties) and a 'regional' area (Upper South Platte Basin plus some areas on the Western Slope). This report summarizes Volume I (Text) and Volume II (Technical Appendices). The present water supply exceeds requirements by about 60 percent; however, the distribution facilities are unbalanced causing water shortages in some communities. By 2010, assuming present expansion plans are implemented, the gap between supply and demand will close. The yearly supply capacity contemplated then (794,000 acre feet) will be matched with an almost equal damand (749,000 acre feet). Water is presently obtained from the South Platte and tributaries, transmountain diversions, and groundwater (wells). Conversion of water from other uses, primarily agricultural, and acquisition of additional water rights will continue to increase the domestic supply. The best potential for the largest additional supply involves the importation of transmountain water. Groundwater is not anticipated to be a major source of additional water. Three alternative organization plans for providing water supply and service are presented. Estimated capital improvement costs range between $824,000,000 and $899,000,000. (See also W70-06186 and W70-06187). (Poertner-Chicago)
W70-06185

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME I - TEXT.
Denver Board of Water Commissioners, Colo.

Denver Regional Council of Governments, July 1969. 110 p, 19 fig, 15 tab, 48 ref. HUD Project No. Colo. P-62.

Descriptors: *Water resources development, *Water supply, *Water demand, *Water shortage, *Planning, *Future planning, Construction, Construction costs, Long-term planning, Financing, Capital costs.
Identifiers: *Denver Board of Water Commissioners, *Denver water supply program, *Denver Regional Council of Governments.

The water resources and requirements of the Denver Metropolitan Area to the year 2010 were investigated and reported upon in two volumes. Volume I is the text for the report, and Volume II contains Technical Appendices. A Summary Report was also published. The geographical area included in the study comprised a primary area which included the City and County of Denver and four other urban counties in the Denver Metropolitan Area. A regional area which included the South Platte River Basin and areas on the Western Slope was also studied. It was found that the present water supply exceeds requirements by about 60 percent. However, assuming that only present plans are implemented, the water demand by the year 2010 will nearly equal the supply capacity planned. Recommendations are included for a capital improvements program which is estimated to cost between a minimum of $824,000,000. The best potential viewed for increasing the available water supply involves the importation of transmountain water. (See W70-06185). (Poertner-Chicago)
W70-06186

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME II - TECHNICAL APPENDICES.
Denver Board of Water Commissioners, Colo.

Denver Regional Council of Governments, July 1969. HUD Project No. Colo. P-62.

Descriptors: *Water resources development, *Water supply, *Water demand, *Planning, *Design criteria, *Future planning, *Water treatment, *Water storage, *Water conveyance, Construction.
Identifiers: *Denver Board of Water Commissioners, *Denver water supply program, *Denver Regional Council of Governments.

Volume II is a compendium of detailed technical information concerning water treatment, pumping, storage and transmission for the 24 largest water supply agencies in the Denver metropolitan region. Criteria were established by the Water Advisory Committee of the Denver Regional Council of Governments to assess objectively each water agency. The per capita consumption experience was documented and summarized for each agency. Projections were made of water consumption on an average-day basis. Ratios of maximum-day to average-day water requirements were used for sizing raw water transmission and pumping. Maximum-hour to average-day ratios were used for siz-

ing transmission and distribution mains, and treated water storage facilities. An addendum to this volume lists for each agency the detailed population projections, water demand forecasts and supply requirements, by census tract, for 1968, 1975, 1990 and 2010. The present and projected service system of each agency is summarized. Scheduled expansion of each agency, where applicable, is described in terms of supply, treatment, storage, transmission and pumping station requirements. Estimated future capital and operating costs of each agency are tabulated. General conclusions regarding joint development of water systems is included. (See W70-06185). (Poertner-Chicago)
W70-06187

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION,
For primary bibliographic entry see Field 06E.
W70-06300

6E. Water Law and Institutions

AVON PARK, INC V STATE (NECESSITY FOR EXPLANATION OF DAMAGES IN CONDEMNATION PROCEEDING).

305 NYS2d 560-563 (1963).

Descriptors: *New York, *Condemnation value, *Eminent domain, *Drainage, Judicial decisions, Condemnation, Cost repayment, Compensation, Value, Damages, Drainage practices, Road construction, Highways, Real property, Land classification, Land appraisal, Land use, Right-of-way, Legal aspects.

In an eminent domain proceeding to appropriate land for highway drainage purposes, the trial court awarded direct damages of $50 per front foot and consequential damages of $3680. Upon appeal, the court held that there was nothing on the record to disturb the award of direct damages. The trial court was also sustained in its finding that the appropriation did not destroy all suitable access and thus change the highest and best use from commercial to residential. An access driveway could still be constructed. The award of consequential damages was set aside by the appellate court because of the lack of a supportive explanation for the award. The court held that a determination based solely on the court's subjective judgment cannot be upheld. (Douberley-Florida)
W70-05917

BUNCH V ABEL (SEPARABILITY OF REPAIR YARDS FROM MARINA).
260 A2d 19-21 (Ct App Md 1969).

Descriptors: *Maryland, *Zoning, *Marinas, *Repairing, Judicial decisions, Water zoning, Cities, Land use, Local governments, City planning, Boats, Inland waterways, Docks, Bulkheads, Construction, Permits, Regulation, Building codes, Administrative agencies, Legal aspects.

Appellees applied for a zoning certificate and building permit for the construction of a bulkhead and seven slips to be added to their existing marina and boatyard. A municipal zoning ordinance did not permit boat repair yards within 500 feet of any residentially zoned district. The new bulkhead was to be within 500 feet of the adjoining residential property, but the application was approved by Planning Commission and affirmed by the Board of Zoning Appeals and the circuit court. Upon appeal, the court of appeals affirmed. Major repairs were done at the marina inside an enclosed building that was physically separated from the proposed bulkhead extension. The boat repair yard and marina were found to be divisible and separate enterprises, and the extension of the marina was not considered as an extension of the repair yard as well. Appellees gave assurances that only minor repairs would be done in the marina area, and on that basis the circuit court was held to be justified in granting the application. (Douberley-Florida)
W70-05921

SIBSON V STATE (JURISDICTION OF PORT AUTHORITY OVER SALT MARSH).
259 A2d 397-400 (N H 1969).

Descriptors: *New Hampshire, *Salt marshes, *Tidal marshes, *Tidal waters, Port authorities, Jurisdiction, Judicial decisions, Legislation, Real property, Marshes, Wetlands, Aquatic environment, Aquatic habitats, Land reclamation, Marsh management, Landfills, Land development, Shallow water, Tides, Legal aspects, Administrative agencies.

The New Hampshire Port Authority denied plaintiff permission to fill a parcel of marshland for residential purposes. The denial was made pursuant to a statute which required approval of the Authority before excavating or filling any bank, flat, marsh, or swamp in or adjacent to tidal waters. The court held that the property did not fall within the purview of the statute, and that the orders issued by the Authority were void for lack of jurisdiction. The court stated that tidal waters are public waters and may be regulated to prevent fill runoff back into tidal waters and to protect marine fisheries and wildlife. However, tidal waters are those in which the tide ordinarily ebbs and flows, and not those affected by the tide only in unusual circumstances. The land here was found not to be in or contiguous to tidal waters, and thus was not subject to regulation by the Authority. (Douberley-Florida)
W70-05972

PIC-N-PAY INC V STATE (JURISDICTION OF PORT AUTHORITY OVER TIDAL MARSH).
259 A2d 659-660 (N H 1969).

Descriptors: *New Hampshire, *Salt marshes, *Port authorities, *Jurisdiction, Judicial decisions, Real property, Marshes, Wetlands, Tidal marshes, Aquatic environment, Aquatic habitats, Land reclamation, Marsh management, Landfills, Land development, Legislation, Legal aspects, Administrative agencies.

Plaintiff owned a parcel of salt marsh that was susceptible to tides. His petition to fill the marsh for commercial purposes was denied by the New Hampshire Port Authority. The Authority stated that it was bound by the restrictive powers of the director of the Fish and Game Department, and the Department had found the salt marsh to be a necessary and vital part of the marine ecological complex. Upon appeal the court found that the land was not within the statutory jurisdiction of the Authority. Consequently, its orders relating to the land were null and void. (Douberley-Florida)
W70-05981

WESTERN CONTRACTING CORPORATION V TITTER (RIGHT OF ACCESS SUBJECT TO FEDERAL NAVIGATIONAL RIGHTS).
258 A2d 600-606 (Ct App Md 1969).

Descriptors: *Maryland, *Riparian rights, *Dredging, *Damages, Judicial decisions, Navigable waters, Navigation, Relative rights, Riparian land, Riparian waters, Banks, Channel improvement, Federal government, Compensation, Access routes, Canals, Excavation, Legal aspects, Administrative agencies.
Identifiers: *Right of access, Obstruction to access.

Defendant was under contract with the Army Corps of Engineers to remove mud and debris from a canal by means of a dredge. The materials were pumped to a disposal area through 500 foot lengths of pipe, part of which extended in the water across the front of plaintiff's property. After the dredging was finished, defendant used a cove in front of plaintiff's property to store pipes until they were floated elsewhere. Plaintiff sued for damages on grounds that his right of access to the water was impaired by the pipes, and the jury returned an award for damages. Upon appeal, the trial court was reversed. The appellate court found that the trial court should have instructed the jury to consider damages only for that period of obstruction not reasonably related to the work of dredging. It stated that the right of access of a riparian owner was subject to the paramount right of the federal government to protect navigation, and that an injury resulting incidentally from such an improvement is not actionable. However, the immunity of the contractor does not protect him from liability for his own negligence if he had full discretion and responsibility for the manner in which the acts causing the injury were carried out. (Douberley-Florida)
W70-05982

POLICE POWER - LANDS - CONSERVATION COMMISSION (IMPROVEMENTS TO WATER-BODIES ON PRIVATE PROPERTY).
For primary bibliographic entry see Field 04D.
W70-05993

CONSERVATION AND PUBLIC PARKS--POLICE POWER (POWERS AND DUTIES OF THE STATE CONSERVATION COMMISSION).

Iowa Code Ann secs 111.3-111.6, 111.18, 111.31, 111.35, 111.53-111.56 (1949), as amended, (Supp 1970).

Descriptors: *Iowa, *Conservation, *Administrative agencies, *Regulation, Lakes, Streams, Access routes, High water mark, Barriers, Islands, Boundaries (Property), Bank protection, Riparian land, Lake ice, Sands, Gravels, Administration, Water conservation, Permits, Legislation, Jurisdiction, Running waters, Piers, Buildings, Docks.
Identifiers: Obstructions.

The State Conservation Commission has the power to maintain, improve or beautify state-owned bodies of water and to provide access routes thereto. No pier, wharf, piling or other erection, except dams, may be built on or over any state-owned water without a permit from the Commission. No structure may be erected in such a manner as to obstruct pedestrian walk-ways between the ordinary high water mark and the water's edge without the Commission's permission. A permit is required to operate any commercial concession on any state-owned waters. The Commission has the power to order the removal of any building or obstruction on state-owned waters if in the best interests of the public. The cost of removal constitutes a lien on the property. The Commission has jurisdiction over all streams and lakes not used by some other governmental body for state purposes. Approval of both the Commission and the executive council is required for the sale of any island in a stream or lake. The Commission may issue permits for the removal of ice, sand, gravel or other materials from waters under its jurisdiction. Banks of lakes and streams cannot be removed without the Commission's permission. (Douberley-Florida)
W70-06012

MASSIE V STATE HIGHWAY COMM'R (EMINENT DOMAIN PROCEEDING).

164 SE2d 696-699 (Va 1968).

Descriptors: *Virginia, *Eminent domain, *Easements, *Compensation, Highways, Condemnation, Legal aspects, Right-of-way, Road construction, Transportation, Highway relocation, Ditches, Judicial decisions, Drainage systems, Local governments, Administrative agencies, Adjudication procedure, Damages.

In a proceeding to acquire land by eminent domain, part of defendant's land was taken for a ditch easement. Defendant was awarded $6750 for the ease-

ment and as damages for contemplated flooding of a portion of defendant's property. The circuit court held the award excessive and ordered defendant to remit $6000. The Supreme Court of Virginia reversed on the grounds that the Highway Commission had not determined the damages on the basis of erroneous principles and that the award was not so grossly excessive as to show prejudice or corruption. (Hubener-Florida)
W70-06147

STATE V BROOKS (OBSTRUCTION OF NAVIGATION, OWNERSHIP OF MARSHLAND).
166 SE2d 70-79 (NC 1969).

Descriptors: *North Carolina, *Navigable waters, *Ownership of beds, *Marshes, Estuaries, Streambeds, Beds under water, Salt marshes, Tidal marshes, Relative rights, Riparian rights, Water law, Judicial decisions, Fisheries, Land tenure, Shellfish, Docks, Obstruction to flow, State governments, Legal aspects.

The State of North Carolina brought an action to remove a cloud on title to a marshland and to compel defendants to remove 1500-2000 chicken crates that were placed in navigable streams of the marshland. Defendants answered denying title in the state and claiming title in themselves. The trial court granted judgment in favor of defendants after the jury found that the title to the land was in defendants and that defendants were not obstructing the navigable streams. The court of appeals affirmed. The supreme court reversed and held that the evidence was insufficient to establish that defendants held the land by adverse possession and remanded the question of state ownership to the trial court. The supreme court also held that the issue of whether the crates that were placed in the streams obstructed navigation had been properly submitted to the jury. (Hubener-Florida)
W70-06164

JURISDICTIONAL PROBLEMS: A BARRIER TO THE IMPLEMENTATION AND COORDINATION OF WATER POLICY,
Mississippi Univ., University. Legal Inst. of Agricultural and Resource Development.
Joel Blass.
Mississippi State University Water Resources Research Institute Report, May 1969. 13 p, 30 ref. OWRR Project No A-999-MISS.

Descriptors: *Water law, *Water policy, *Reviews, *Mississippi, Institutional constraints, Interstate, Water allocation (Policy), Water demand, Water resources development, Legislation, Prior appropriations, Riparian rights, Water rights.
Identifiers: Jurisdictional problems (Water law).

State and national water development policies are critically reviewed, using problems and policies in Mississippi as illustrations. The two basic concepts in water law are riparian and appropriation. The greater territorial portion of the U.S. inherited the riparian doctrine from the English. This approach to water law is not suitable except in some areas where there is an abundant supply. Appropriation is also based on the ownership of land, but the right is obtained simply by appropriation and application to some beneficial use. Unlike the riparian right, the right of appropriation may be lost by a liberating prescription through non-use. Mississippi's basic water rights law was originally the riparian doctrine. In 1956 the State Legislature adopted a Surface Water Appropriation Act. Both Mississippi's experience and the example of the State of Oregon indicate that jurisdictional problems may be no real or serious barrier to the implementation and coordination of water policy, but that the various States and the Federal Government have simply not formulated any water policy. The problems, and the waters themselves, frequently cross county and State lines. It is not sufficient that the States alone develop water policies, but the combined resources of the States must be coordinated. The creation of a national water commission and the initiation of a broad analysis of all major aspects of the nation's water problems are suggested. (Knapp-USGS)
W70-06183

REGULATIONS APPLYING TO SPECIFIC VARIETIES OF FISH.

Del Code Ann tit 7, secs 931-936 (1953).

Descriptors: *Delaware, *Fishing, *Commercial fishing, *Nets, Fishing gear, Carp, Trout, Fish management, Estuarine fisheries, Stream fisheries, Fish conservation, Sport fishing, Rivers, Bays, Estuaries, Legislation, Legal aspects, State governments.

Provisions regulate the methods by which carp, herring, rock, shad, sturgeon, mammose, trout and weak fish may be taken in Delaware River or Bay. The size of the fish and the seasons in which they may be caught are also controlled. Penalties and fines are provided for violation of the provisions. (Hubener-Florida)
W70-06191

OUTLAW V OUTLAW (BOUNDARY DISPUTE).
165 SE2d 845-846 (Ga 1969).

Descriptors: *Georgia, *Non-navigable waters, *Boundaries (Property), *Boundary disputes, Water law, Judicial decisions, Legal aspects, Swamps, Marshes, Relative rights, Natural streams, Streams, Natural flow, Watercourses (Legal).

In an action to determine the boundary dividing certain lands, plaintiff contended that the line was the center of a non-navigable stream running through a swampy area known as Beaver Dam Bay. The defendant contended that the line was the north side of Beaver Dam Bay. The deeds designated the boundary only as Beaver Dam Bay. The trial court found for plaintiff. The supreme court affirmed, holding that where land is bounded by a non-navigable stream, the boundary line of such land is the thread of the stream. (Hubener-Florida)
W70-06194

REAL PROPERTY--RIGHT TO FLOAT-FISH THROUGH ANOTHER'S LAND,
Bill Doshier.
Arkansas Law Review, Vol 10, No 1, p 145-149, Winter 1956. 5 p.

Descriptors: *Arkansas, *Missouri, *Riparian rights, *Non-navigable waters, Navigable waters, Rivers, Running waters, Streams, Ownership of beds, Riparian waters, Streambeds, Fishing, Sport fishing, Water utilization, Public rights, Legal aspects, Water law, Water rights, Fly fishing, Judicial decisions, Relative rights.

In a Missouri case plaintiff asserted his right to fish on a stream navigable by canoe but not by larger vessels. The court affirmed this right though defendant had posted and fenced the water enclosed between banks he owned. Application of such a rule to Arkansas would conflict with those precedents restricting public rights to waters navigable in fact. The right to float-fish on a waterway depends on the navigability of the stream. The state owns the beds of navigable waterways. Navigable waterways are by the weight of authority those navigable in fact. The fact that a stream is fishable does not make it navigable. A navigable stream must be navigable for commercial purposes. Some courts in other states give rights to the public in non-navigable streams. These rights are in the nature of an easement for public use. Arkansas does not follow this rule. The Arkansas owner has the exclusive right to fish a non-navigable stream and owns the bed. The Missouri court relied on a statute of the Territory of Missouri, of which Arkansas was a part, granting public rights in such streams. The statute is obsolete and will not be applied in Arkansas. (Dye-Florida)
W70-06195

REAL PROPERTY - RIPARIAN RIGHTS - ACCRETION, RELICTION, AND AVULSION.
Arkansas Law Review, Vol 6, No 1, p 68-71, Winter 1952. 4p.

Descriptors: *Arkansas, *Accretion (Legal aspects), *Avulsion, *Boundaries (Property), Navigable rivers, Banks, Legal aspects, Legislation, Navigable waters, Relative rights, Severance, Water law, Land tenure, Real property, Bank erosion, Boundary disputes, Riparian land, Judicial decisions, Riparian rights, Shores, Islands.

In an action to quiet title, plaintiff alleged the land in question, on a navigable river, to have been formed by accretion to his land. The land was later separated from the shore by avulsion. Defendant claimed that the land had formed by accretion to his island in the river. The court held that the new land had formed by accretion to the plaintiff's land, but was the defendant's through adverse possession. Accretion is the building up of land by water receding therefrom and filling in by deposits of earth. Avulsion results from a sudden change in the course of a waterway. Land formed by accretion generally belongs to the owner of contigious land. An Arkansas statute allows such owner to retain title when avulsion separates newly formed land from the owner's original property. Where land forms as an accretion to an island, title does not rest in the owner of the main shore. The concepts of accretion seem to have been correctly applied in the instant case. (Dye-Florida)
W70-06196

LAW OF THE SEA--CONTINENTAL SHELF--GOVERNMENT APPROVAL IS REQUIRED FOR CONSTRUCTION OF ARTIFICIAL-ISLAND NATIONS OFF THE COAST OF FLORIDA.
Virginia Law Review, Vol 55, No 5, p 1005-1011, June 1969. 7 p, 24 ref.

Descriptors: *Florida, *Continental Shelf, *Islands, *Submerged Lands Act, Rivers and Harbors Act, Reefs, Law of the sea, Oceans, Legislation, Judicial decisions, Dredging, Bulkheads, International law, Beds, Beds under water, Federal government, Relative rights, Ownership of beds, Legal aspects, United States, Marine fisheries.

In United States v Ray, 294 F Supp 532 (S D Fla 1969), the defendant attempted by dredging operations to create an artificial island about 5 miles off the Florida coast. The United States intervened to halt the dredging. The district court found that the erection of the island would damage reefs and their marine life and restrained further activity. The court ruled that the Continental Shelf is subject to the exclusive control of the United States on the basis of Presidential Proclamation, the Submerged Lands Act, and the Outer Continental Shelf Lands Act. This law review article cites laws, conventions, treaties and articles on legal aspects of the Continental Shelf and the rights to exploitation of it. There are numerous definitions of the Continental Shelf and numerous authorities and laws which affect the right to ownership and exploitation of the seabed and its natural resources. (Hubener-Florida)
W70-06199

PUBLIC RELATIONS, LAW, ENVIRONMENTAL POLLUTION,
Cleveland State Univ., Ohio.
For primary bibliographic entry see Field 05G.
W70-06200

CONSIDERATION OF ANTICIPATORY USES IN DECISIONS ON COASTAL DEVELOPMENT,
Rhode Island Univ., Providence. Dept. of Political Science.

Daniel Wilkes.
San Diego Law Review, Vol 6, No 3, p 354-374, July 1969. 21 p, 60 ref.

Descriptors: *Decision making, *Coasts, *Water policy, *Planning, Competing uses, Bench marks, Future planning (Projected), Sands, Beaches, Recreation demand, Tidal powerplants, Zoning, Coastal marshes, Water zoning, Landfills, Legal aspects, Project purposes, Social needs, Public rights, Environmental effects, National seashores.
Identifiers: *Coastal management systems, Coastal development.

Decisions on coastal development must be based on consideration of possible future uses as well as proposed present uses. The present process for making decisions on coastal development is analyzed. The decisional process used today is geared to rule out consideration of possible future activities on the same location. The factors responsible for this decisional short-sightedness are identified and various solutions suggested. Existing devices available to insure that future activities are not ignored in planning contemporary uses are listed. Creative devices for insuring consideration of future uses in planning decisions are recommended. These special devices are borrowed from other areas and include: ombudsmen for the future; special report sections; historical analyses; and special tribunals. (Cuevas-Florida)
W70-06201

INTERNATIONAL LAW-CONTINENTAL SHELF--PROPRIETARY INTEREST OF UNITED STATES IN CONTINENTAL SHELF PRECLUDES CLAIMS OF ACQUISITION BY PRIVATE ENTREPRENEURS--UNITED STATES V RAY (S D FLA 1969),
Sherry Eckhardt.
San Diego Law Review, Vol 6, No 3, p 487-501, July 1969. 15 p, 70 ref.

Descriptors: *Continental shelf, *International law, *Oceans, *Ownership of beds, Beds, Law of the sea, Navigation, International waters, Reefs, Legislation, Legal aspects, Judicial decisions, Jurisdiction, Federal jurisdiction, Bulkheads, Dredging, Exploration, Exploitation, Resource development, Construction, Public lands.

In United States v Ray, 294 F Supp 532 (S D Fla 1969), the district court enjoined two private corporations' construction of buildings and bulkheads atop coral reefs situated on the continental shelf outside the United States' territorial waters because the construction was destroying irreplaceable natural resources of the seabed. The court held that the reefs were within the territorial jurisdiction of the country. The continental shelf doctrine holds that resources of the seabed and subsoil of the area adjacent to a coastal state are subject to its exclusive jurisdiction and control for purposes of exploration and exploitation. Rights exercised by the United States over the continental shelf are of a limited nature. The background of United States' claims to the shelf are given. Through federal legislation dealing with public lands, the United States has applied its territorial legal system to the shelf. This extension of its domestic law underscores United States' dominion over the shelf. Other recent attempts by private entrepreneurs to make use of the continental shelf are cited. Up to now, the United States has never accepted the theory that the shelf is subject to acquisition in a territorial sense. In the future, similar operations may require a showing of shelf ownership by the government before they are thwarted by the courts. (Cuevas-Florida)
W70-06202

SOME LEGAL QUESTIONS ON THE PEACEFUL USES OF OCEAN SPACE,
Denver Univ., Colo. Coll. of Law.
Ved P. Nanda.
Virginia Journal of International Law, Vol 9, No 2, p 343-407, May 1969. 65 p, 295 ref, 2 append.

Descriptors: *Law of the sea, *Resource allocation, *Water resource development, *International waters, Exploitation, Foreign countries, Governments, Natural resources, Planning, International law, Organizations, Political aspects, Regulation, Ownership of beds, Military aspects, Social aspects, United Nations, International commissions, International waters, Treaties, Institutions, Continental shelf, Oceans.
Identifiers: *Freedom of the seas.

Recent advances in science and technology pose serious challenges to traditional laws and legal institutions. The purpose of this paper is to note current developments in the ocean space arena, especially at the United Nations level. Possible alternatives are evaluated in light of the objectives set by the United Nations General Assembly for utilization of the ocean's resources in the interests of mankind. Four questions are discussed: the extent of national jurisdiction beyond internal waters; alternative legal remedies for deep ocean resources; limits on military uses of the seas; and limitations on freedom of the seas. Freedom of the seas is not an absolute concept. It means each state is free to use the oceans in accommodation with other uses. It has a built-in limitation of reasonable use. There is a need for reaffirmation of this principle of free access to the sea. Some agreement must be reached as to coastal states' right to explore and exploit resources of the ocean floor and its subsoil. An international agency to handle administration of ocean resources lying beyond limits of national jurisdiction is recommended. (Cuevas-Florida)
W70-06203

MAINE LEGISLATIVE RESEARCH COMMISSION: SUBCOMMITTEE REPORT AND PROPOSED LEGISLATION (OIL DISCHARGE PREVENTION AND POLLUTION CONTROL).
For primary bibliographic entry see Field 05G.
W70-06204

CONFERENCE--POLLUTION OF LAKE MICHIGAN AND ITS TRIBUTARY BASIN, ILLINOIS, INDIANA, MICHIGAN, AND WISCONSIN.
For primary bibliographic entry see Field 05G.
W70-06205

PARK COMMISSIONERS (LAKES IN PUBLIC PARKS).

Iowa Code Ann sec 370.29 (Supp 1970).

Descriptors: *Iowa, *Lakes, *Meanders, *Parks, Boundaries (Property), Legal aspects, Legislation, Taxes, Financing, Administration, Administrative agencies, Conservation, Landscaping, Recreation, State governments, Cities, City planning, Construction, Dikes, Levees, Water supply, Water utilization, Regulation.

Prior to 1880, cities received grants of title to meandered lakes within their corporate limits from the United States. If such lakes are put to public uses, recreation and park purposes for at least twenty years, the boards of park commissioners are authorized to collect an additional tax, not exceeding one mill each year. Such monies are to be used solely for improving such lakes by dredging or otherwise deepening them, constructing dikes and levees, and changing their form and size. The money is also to be used for the regulation, control and improvement of the water supply, the beautification of the lake and surrounding land, and the purchase of equipment for public use and pleasure. (Barnett-Florida)
W70-06239

STATE PUBLICITY (STATE PUBLICITY AND PARKS COMMISSION CREATED).
Ark Stat Ann sec 9-202 (1956).

Descriptors: *Arkansas, *Water resources, *Administrative agencies, *Area redevelopment, Parks, Labor, Legislation, Local governments, State governments, Aesthetics, Conservation, Legal aspects, Regulation, Administration, Land use, Recreation, Natural resources, Labor supply, Industries, Social aspects, Education, Environment, Population, Social change.

A State Publicity and Parks Commission is created as an extension of the State Park System. Its purpose is to encourage the establishment of new industrial enterprise and to expand the tourist industry of Arkansas by promoting the natural resources and other attributes of the state. The Commission is to furnish authentic and favorable information about the state with regard to its: (1) agricultural and industrial possibilities; (2) cultural attainments; (3) historical background; (4) educational, religious, and recreational facilities; and (5) resources and transportation facilities. The Commission shall consists of seven members, two of whom shall be active newspaper or editorial workers or editors. Each congressional district shall be represented on the Commission. (Barnett-Florida).
W70-06240

RECENT DEVELOPMENTS IN WATER LAW (LANDOWNER'S RIGHT TO MAKE REASONABLE USE OF PREMISES),
Clyde, Mecham and Pratt, Salt Lake City, Utah.
Edward W. Clyde.
Natural Resources Lawyer, Vol 1, No 4, p 51-59, Oct 1968, 9 p.

Descriptors: *Judicial decisions, *Reasonable use, *Federal Reclamation Law, *Relative rights, Legal aspects, Competing uses, Alteration of flow, Natural flow doctrine, Obstruction to flow, prior appropriation, Riparian rights, State governments, Regulation, Dams, Reservoirs, Percolating water, Underground streams, Water pollution, Legislation, Reclamation.

Recent state court decisions that have construed the right of a landowner to make reasonable use of his own land are discussed. Two types of conflicts have arisen over this point. One involves drainage or activity on one's own land which interferes with the water rights of others. The other conflict develops when one seeks to drain his land and to discharge the drainage water on lower lands. After a summary presentation of the holdings of various state courts dealing with the above stated problems, the author goes on to make one further distinction. If two contestants are each contending for the right to use water which can be developed from wells, drains, or development of one's own land, the problem is governed by the rules of water law. When the case involves no competition for the use of the water, but rather is a claim by one landowner that he has a right to make reasonable use of his own land, an entirely different set of rules apply. The article goes on to cite various authorities with regard to the reasonable use doctrine. The 160 acre limitation of the Reclamation Law is discussed in light of cases now pending in the California courts. (Barnett-Florida)
W70-06284

MISCELLANEOUS PROVISIONS FOR THE REGULATION AND PROTECTION OF FISH AND GAME.
Tenn Code Ann secs 51-501 thru 51-513 (1966).

Descriptors: *Wildlife conservation, *Tennessee, *Fish, *Regulation, Administrative agencies, Wildlife, Birds, Game, Fishing, Hunting, Pike, White bass, Trout, Fish ladders, Permits, Bodies of water, Lakes, Rivers, Streams, Docks, Dams, Water pollution, Refuse, Legislation, Legal aspects.

Except as provided, the purchase, use, possession of, and traffic in protected game and fish are prohibited. Anyone desiring to take protected game or fish must comply with regulations concerning licensing, limitations on quantity, and

procedures for shipping. The duties of persons shipping game or fish or placing such in cold storage are outlined. Licensed wholesale dealers may purchase certain fish from out-of-state sources but must notify the Director of the Game and Fish Commission of such purchases and keep records for inspection. The private use of state-owned waters and bordering lands is regulated. All owners of dams constructed across streams must, if necessary for the free passage of fish, erect fish ladders. Specified locks and dams across large rivers, and dams which produce electricity, are exempted from this requirement. Pollution injurious to fish life in public or private waters is prohibited. Continued violation of this water pollution provision constitutes a public nuisance subject to abatement by permanent injunction. (Duss-Florida)
W70-06285

PUBLIC ATTITUDES TOWARD WATERSHED MANAGEMENT,
N. E. Spangenberg.
Journal of Soil and Water Conservation, Vol 24, No 6, p 232-234, Dec 1969. 3 p, 2 ref.

Descriptors: *Water policy, *Administration, *Watershed management, Forest management, Water management (Applied), Water supply, Water sources, Water quality, Water quality control, Water resources, Planning, Water resources development.

Public response to professional watershed management may restrict the planning activities of managers. A survey of watershed managers indicates that public response is limited to one to five percent of the residents of a watershed and is concerned with the quality of water at the tap rather than management policy. Questionnaires were sent to city water managers and national forest supervisors in six western states, questioning them as to the quantity and quality of complaints addressed to them as water managers. The results indicated that the public is interested in watershed management only in cases of water quality emergencies--changes in color, odor, or taste of water at the tap. City managers received complaints, largely in the form of telephone calls, whereas forest managers received complaints by letter, perhaps as a result of unavailability. A greater quantity of response was noted by forest managers. Water managers should make the public more conscious of the water resource and its relation to the community in order to secure funds to implement water policies. (Dye-Florida)
W70-06286

WHO OWNS THE MINERAL RIGHTS IN HUDSON BAY,
Charles Birt.
Manitoba Law Journal, Vol 3, No 2, p 41-52, 1969. 12 p, 25 ref.

Descriptors: *Bays, *Water rights, *Water law, *Ownership of beds, Riparian rights, Legislation, Legal aspects, Preferences (Water rights), Prior appropriation, Boundaries (Property), Boundary disputes, Low water mark, Bodies of water, Governments, Judicial decisions, International law, Internal water, Mineralogy, Foreign waters, Relative rights.
Identifiers: Canada.

The Royal Charter of 1670 granted to Hudson's Bay Company only specified mineral rights, ie., gold, silver, gems and precious stones. All other rights were retained on behalf of the Crown. The British North America Act of 1867 transferred the limited mineral rights of the Hudson's Bay Company to Canada. The complete transfer of mineral rights did not occur until 1880 when Britain gave up her last remaining possessions in Canada. The federal government on behalf of Canada became the possessor of these mineral rights. Canada claims, under international law, that Hudson Bay is 'internal' water under the Historic Bay Principle. Canada, ie., the federal government, has never transferred these mineral rights to either Ontario, Quebec or Manitoba. Their boundaries were extended in 1912 to the low water mark of Hudson Bay. The provinces were given the mineral rights that lay within their boundaries but nothing was ever said about Hudson Bay. Therefore, the federal government retained them for Canada. The legal position today is that Canada owns the mineral rights in the sea bed of Hudson Bay. (Powell-Florida)
W70-06288

ON THE NON-UTILITY OF DOMESTIC WATER TRANSPORT REGULATION,
Pennsylvania State Univ., University Park. Dept. of Business Administration.
John C. Spychalski.
ICC Practitioner's Journal, Vol 37, No 1, p 7-20, Nov-Dec 1969. 14 p, 63 ref.

Descriptors: *Water conveyance, *Water transfer, *Transportation, *Regulation, Legal aspects, Inland waterways, Railroads, Ships, Canals, Pipelines, River regulation, Administrative agencies, Federal government, Political aspects, Economies of scale, Economics, Economic impact, Economic justification, Economic feasibility, Water law.

Part III of the Interstate Commerce Act subjects domestic for-hire freight and passenger traffic on rivers and canals, the Great Lakes, and coastal and intercoastal ocean routes to economic regulation by the Interstate Commerce Commission. Such regulation is assessed with regards to economic and environmental aspects of domestic water transportation. The causes and content of water carrier regulation, including the conditions leading to Part III's enactment and the major provisions of Part III, are reviewed. Economic justification of water carrier regulation depends upon its contribution to the achievement of several objectives: (1) the avoidance of monopoly profits; (2) the efficient performance of inland water transport firms; (3) a sufficient supply of water transport services; and (4) the prevention of cutthroat competition. The price system's ability to fulfill the above objectives without intervention by Commission regulation is demonstrated. Formidable economic barriers do not confront the firm contemplating entry into inland water transport. The nature of domestic eater transport's demand and cost conditions prevents the typical water carrier firm from generating monopoly profits. The regulation-immune movement of certain water-borne freight under terms of the bulk and liquid exemptions empirically demonstrates the workability of unregulated water carrier competition. Available evidence indicates that economic regulation of domestic water transport should be eliminated. (Powell-Florida)
W70-06289

POLLUTION, LAW, SCIENCE, AND DAMAGE AWARDS,
For primary bibliographic entry see Field 05G.
W70-06290

THE STATUS OF MINERAL RESOURCES ON THE OCEAN FLOOR.
California Western Law Review, Vol 5, No 2, p 299-312, Spring 1969. 14 p, 85 ref.

Descriptors: *Oceans, *Resource allocation, *Mineralogy, *Ownership of beds, Resources, Mineral industry, Mining, Legal aspects, Geology, Resource development, Water resources development, Land resources, Natural resources, Conservation, Continental slope, Continental shelf, Law of the sea, Shores, Appropriation, Riparian rights, Water rights, Beds under water, Regime, Coasts, Internal waters, Water types.

Allocations of jurisdiction and control over the ocean are surveyed. The ocean is traditionally divided into five zones: (1) internal waters; (2) territorial sea; (3) contiguous zones; (4) continental shelf; and (5) high seas. Each zone is defined and discussed. The oceans should be divided in terms of the geological structure of the ocean bottoms which includes: (a) the continental shelf; (b) the continental slope; and (c) the deep ocean floor. There is a need for a legal system to determine the sovereignty or control over the minerals on the continental shelves and deep sea areas of the world. There are two general theories dealing with the status of the mineral resources of the deep sea floor. One theory treats these minerals as the common property of the international community and incapable of appropriation by any one nation. The second theory treats these minerals as belonging to no one and therefore subject to acquisition by individual nations. Other possible theories of allocation of mineral resources include: (1) the unlimited extension of the continental shelf; (2) literal extension of the doctrine of the Convention on the Continental Shelf; (3) the flag state theory; and (4) the international agency theory. The extent of the coastal state's ownership of minerals adjacent to its coast should be to the foot of the continental slope. Beyond the slope the appropriation and status of the mineral resources should be controlled by a regime of the deep sea. (Powell-Florida)
W70-06291

NAVIGABILITY IN THE MISSOURI RIVER BASIN,
Alvin E. Bielefeld.
Land and Water Law Review, Vol 4, No 1, p 97-119, 1969. 23 p, 106 ref.

Descriptors: *Missouri River, *Navigable rivers, *River basins, *River basin development, River regulation, River beds, Impoundments, Irrigation systems, Electric power-plants, Federal-states water rights conflicts, Federal reservations, Reservoir operation, Competing uses, Conservation, Prior appropriation, Indian reservations, Federal government, State governments, Regulation, Judicial decisions, Legal aspects, Ownership of beds.
Identifiers: *Missouri River Basin.

Navigability has a significant effect on the development of the Missouri River Basin. The physical characteristics of navigability are reviewed and the methods of showing navigability by physical characteristics are discussed. Incidents of navigability, such as the commerce servitude and state ownership of beds, are explored. An examination of the consequences of navigability of streams is made in light of the Flood Control Act of 1944 and other applicable legislation. The instances of cooperation and conflict between the states and the federal government as a result of a finding of navigability in general are also examined. Finally, an examination is made of the rights of the various Indian tribes in federally reserved beds and water of the Basin. (Barnett-Florida)
W70-06294

RECENT DEVELOPMENTS AFFECTING PUBLIC LANDS OF THE STATES--1968,
Owen Olpin.
Natural Resources Lawyer, Vol 2, No 3, p 229-237, July 1969. 8 p, 46 ref.

Descriptors: *Navigable waters, *Riparian rights, *Ownership of beds, *Accretion (Legal aspects), Judicial decisions, Legislation, Riparian waters, Boundaries (Property), Eminent domain, Condemnation, Federal government, Beaches, Shores, Recreation, Mineralogy, Oil, Natural gas, Natural resources, Legal aspects, Mining.

In 1968 there were a number of important judicial and legislative developments affecting navigable waters and adjoining uplands. The cases involving ownership of beds of navigable waters were decided upon the principles that new states are admitted on an equal footing with the other states and that the United States holds title to beds of navigable waters in trust for future states. Two cases involving accretion determined that the owner of the land bounded by navigable water acquired the

rights to any natural and gradual accretion formed along the shore. In a seaward boundary case in Hawaii, an upland owner was held entitled to accretions resulting from violent volcanic action. In the area of open beach laws, Hawaii has accomplished by judical decision what Oregon has attempted by its Beach Bill. Offshore oil, gas and mineral exploration was the subject of a Mississippi constitutional amendment. The settlement of native land claims was the subject of statutory and case law in Alaska. The Utah Supreme Court held that the multiple use amendment to that state's mineral leasing laws prohibited the issuance of an oil and gas lease on state lands already covered by a bituminous sands lease. The Nevada Supreme Court implicitly recognized the right of private condemnation for mining purposes provided there is a fair and proper method for computing the amount to be paid to the owner for his land. (Powell-Florida)
W70-06296

NOTES ON VIRGINIA WATER LAWS AND AGENCIES.
Virginia Dept. of Conservation and Economic Development, Richmond, Va. Div. of Water Resources.

Dept of Conservation and Economic Development, Revised 1964. 34 p.

Descriptors: *Virginia, *Water law, *Judicial decisions, *Legislation, Administrative agencies, Federal government, Surface waters, Legal aspects, State governments, Local governments, Groundwater, Navigable waters, Riparian waters, Riparian land, Diversion, Soil conservation, Water conservation, Drainage districts, Water resources.

Much of the water law of Virginia is case law which is not fully developed. Significant Virginia court decisions affecting both surface and groundwater are enumerated and annotated. Surface water cases involve diversion, navigability, riparian land, riparian rights and property rights. Groundwater decisions cover definition, rights and diversion. Statutory provisions affecting water resources are listed. The subject matter of such provisions is arranged according to the individual, agency or governing body having the authority, the right, or the responsibility indicated. Statutes relating to Soil and Water Conservation Districts, Sanitary Districts, Water and Sewer Authorities, Public Facilities Districts, Sanitation Districts, and Drainage Districts are discussed. Water resources statutes concerning counties, cities and towns, the Commonwealth, the Governor and the courts are surveyed. Water law provisions involving the State Corporation Commission, the Commission of Fisheries, the Commission of Game and Inland Fisheries, the Highway Commission, the Soil and Water Conservation Commission, the Potomac River Basin Commission and the Ohio River Valley Water Sanitation Commission are presented. Virginia water law statutes relating to the Department of Conservation and Economic Development, the Division of Water Resources, the Division of Mineral Resources, the Virginia State Ports Authority, the State Water Control Board, the Department of Health and the Advisory Council on the Virginia Economy are examined. (Powell-Florida)
W70-06297

RECENT DEVELOPMENTS IN INTERNATIONAL ENVIRONMENTAL POLLUTION CONTROL,
For primary bibliographic entry see Field 05G.
W70-06298

CONFERENCE COMMITTEE, NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, HR REP NO 91-765, 91ST CONG, 1ST SESS.
For primary bibliographic entry see Field 05G.
W70-06299

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION,
Gary D. Weatherford.
U C L A Law Review, Vol. 15, No 5, p 1299-1346, Sept 1968. 47 p, 227 ref.

Descriptors: *California, *Water allocation (Policy), *Riparian rights, *Equitable apportionment, Watershed protection, Alteration of flow, Competing uses, Legal aspects, Legislation, Prior appropriation, Reasonable use, Relative rights, Water sources, Water utilization, Resource development, Beneficial use, Diversion, Priorities, Area development, Federal government, Institutions, Interstate, State governments, Economic efficiency.

This article deals with inter-regional water diversion and the division of water between claimants who are comparatively close to and distant from the water's edge. Close attention is paid to the development of riparian water law in the western states, as affected by the imposition of regulations by the state legislatures. This legal development is first illustrated by a discussion of California's regulation of the diversion of waters from northern basins to the south and then by a survey of regulations in seven other western states. Attention is given the treatment of water rights between co-riparian states and between riparian and non-riparian states. Consideration is given to the applicability of the doctrine of area-of-origin and to the requirement of diligent water use, illustrated by reports on the Colorado River Basin Act, the National Water Commission Act, and the Northwest-Southwest hydro-power intertie. The economic problems of regional protection of water are discussed. An appendix is included which contains recommendations for reciprocal protection and regulation of intrastate and interstate water allocation. (See also W70-06301 thru W70-06306). (Dye-Florida)
W70-06300

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (DEVELOPMENT OF WESTERN AND CALIFORNIA WATER ALLOCATION LAW),
Gary D. Weatherford.
U C L A Law Review, Vol 15, No 5, p 1299-1311, Sept 1968. 13 p, 58 ref.

Descriptors: *California, *Prior appropriation, *Riparian rights, *Water allocation (Policy), Watershed protection, Alteration of flow, Competing uses, Legal aspects, Legislation, Relative rights, Water law, Water sources, Resource development, Diversion, Area development, State governments, Water demand, Administration, History, Water requirements, Irrigation water, Water shortage, Water supply, Priorities.

Conflicts between areas of origin (where water originates) and areas of delivery (where water is exported from its natural watershed) have been settled in western water law by resort to the doctrines of prior appropriation and riparian rights. Prior appropriation gives rights in water to whoever first uses it. Riparian law cedes rights to owners of land adjacent to natural watercourses and normally does not allow its diversion from the watershed. Prior appropriation early gave way in California to a modified riparian system whereby water could be diverted only when not of beneficial use to claimants within the watershed. Increased water needs in the West led to state administration of water distribution, sometimes limited to water not previously in beneficial use. In the 1920's California enacted statutes designed to utilize the surplus water of the Sacramento River in the semi-arid San Joaquin Valley. Amendments to the statutes limited diversion to water unnecessary for the development of the area of its origin. Riparian water-needs developing after state diversion were accorded priority over needs outside the watershed. (Dye-Florida)
W70-06301

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (INTRASTATE DIVERSION OF WATER FROM AREAS-OF-ORIGIN IN THE WEST),
Gary D. Weatherford.
U C L A Law Review, Vol 15, No 5, p 1311-1317, Sept 1968. 7 p, 35 ref.

Descriptors: *California, *Water allocation (Policy), *Watershed protection, *Equitable apportionment, Diversion, Riparian rights, Competing uses, Legal aspects, Legislation, Prior appropriation, Relative rights, Water sources, Resource development, Area development, Water demand, Priorities, Water requirements, State governments, Arizona, Colorado, Nebraska, Oklahoma, Oregon, Texas, North Dakota.

The State Water Project of the early 1950's, designed to transport surplus northern water to southern California, focused attention on the county-of-origin and watershed-of-origin provisions of the California Water Code. Southern interests proposed bills to secure water contracts under the program, while northern interests demanded protection for their water supplies. The result was a law securing water contracts while the bonds financing the project were outstanding, and providing funds for development of water resources in the areas of origin. Arizona, Colorado, Nebraska, Oklahoma, Oregon and Texas provide protection for the needs of areas of origin by statute. North Dakota allows more liberal diversion of water from natural watersheds. All these states allow diversion of water under clear conditions of surplus. Some require the consent of local water boards as a condition of diversion from the boards' areas. (Dye-Florida)
W70-06302

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (INTERSTATE WATER DISPUTES; AREA-OF-ORIGIN AND STATE-OF-ORIGIN DOCTRINES),
Gary D. Weatherford.
U C L A Law Review, Vol 15, No 5, p 1317-1323, Sept 1968. 7 p, 29 ref.

Descriptors: *Water allocation (Policy), *Interstate, *Riparian rights, *Prior appropriation, Watershed protection, Competing uses, Legal aspects, Reasonable use, Relative rights, Water law, Watersheds (Basins), Diversion, Area development, Institutions, State governments, Resource development, Water demand, Water sources, Judicial decisions, Water utilization, Equitable apportionment.
Identifiers: *Interstate conflicts.

Disputes between co-riparian states often arise, where the boundary line between the states cuts through a common watershed, when diversions by the upstream state reduce water flow to the downstream state. As between states sharing the natural advantage of a watercourse, a claim to preferential treatment on watershed-of-origin grounds has not been recognized by the courts. Under the prior appropriation doctrine water rights are perfected by diligent use and lost by non-use. Diligent use is important in that injunctive relief may be denied without a showing of present injury; without a showing of present use, injury will be difficult to establish. Riparian theory allows preservation of rights in surplus water for future use. Early cases applied the principle of state sovereignty to cases involving the diversion of intrastate water to states outside the watershed of origin. Later cases have held that state restrictions of diversion unduly burden interstate commerce. (Dye-Florida)
W70-06303

LEGAL ASPECT OF INTERREGIONAL WATER DIVERSION (INTERSTATE WATER DIVERSION--LEGAL DEVELOPMENTS),
Gary D. Weatherford.
U C L A Law Review, Vol 15, No 5, p 1323-1334, Sept 1968. 12 p, 68 ref.

Descriptors: *Interstate, *Water allocation (Policy), *Equitable apportionment, *Legislation, Watershed protection, Riparian rights, Legal aspects, Competing uses, Relative rights, Water law, Watersheds (Basins), Water sources, Water utilization, Resource development, Diversion, Area development, Institutions, State governments, Political aspects, Hydroelectric power, Water demand, Federal government, Water utilization, California, Regions.

The Pacific Southwest Water Plan, designed to divert California water into Arizona, aroused opposition in California. As the state-of-origin, California desired explicit guarantees that the cost of water development in California would not increase as a result of the Plan. The Plan failed to become law. When the Colorado River Basin Project Act was first introduced, it embodied the California Pacific-Southwest-Plan requests. The Northwestern states, from which the water was to be diverted, protested that the guarantees accorded them were not sufficient. The Act was re-introduced bearing guarantees of federal funds to insure low-priced water in areas-of-origin. There was also provision for establishing a National Water Commission to evaluate the needs of areas-of-origin and areas-of-delivery and to develop comprehensive plans for the solution of water problems. Stringent area-of-origin protection is also included in the development of the Pacific Northwest-Pacific Southwest hydro-power intertie. Power generated by rivers in the Northwest may be delivered outside the region only to the extent that such power exceeds the needs of the regions wherein the power-generating water originates. (Dye-Florida)
W70-06304

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (ECONOMIC FACTORS AFFECTING INTERREGIONAL WATER DIVERSION),
Gary D. Weatherford.
U C L A Law Review, Vol 15, No 5, p 1334-1343, Sept 1968. 10 p, 37 ref.

Descriptors: *Water distribution (Applied), *Water allocation (Policy), *Economic efficiency, *Diversion, Economics, Marketing, Watershed protection, Riparian rights, Competing uses, Legal aspects, Legislation, Relative rights, Water sources, Water utilization, Resource development, Priorities, Area development, Federal government, State governments, Regions, Water rights, Appropriation, Political aspects, Government finance, Contracts.

The region-of-origin restrictions placed upon water diversion probably must be viewed as impediments to economic efficiency in water distribution. Free market conditions do not prevail in federal water resource development. Guaranteed subsidies for regions of origin serve much the same purpose as revenues from sales of water would in a market economy. Increased transferability of existing rights in appropriated waters might lead to a more economic allocation of water resources. The same theory might also be applied to presently unappropriated waters if these waters were apportioned among the riparian states; the states could then transfer them by sale. Such sales would involve constitutional issues if water is priced so high as to burden interstate commerce. Such a system would also require more precise definitions of regional public, deficiency, surplus, and need. Political allocation is likely to continue, but the national public interest should be an increasingly important factor in its development. (Dye-Florida)
W70-06305

LEGAL ASPECTS OF INTERREGIONAL WATER DIVERSION (RECOMMENDATIONS FOR REGULATION OF INTERREGIONAL WATER ALLOCATION),
Gary D. Weatherford.
U C L A Law Review, Vol 15, No 5, p 1343-1346, Sept, 1968. 4 p.

Descriptors: *Equitable apportionment, *Water allocation (Policy), *Water distribution (Applied), *Diversion, Watershed protection, Riparian rights, Competing uses, Legal aspects, Legislation, Relative rights, Watersheds (Basins), Water sources, Resource development, Water utilization, Priorities, Area development, Federal government, Institutions, State governments, Political aspects, Government finance, Regions, Economic efficiency, Allotments, Coordination.

The following recommendations are based on assumptions that: (1) the transfer of water from one region to another is imminent and (2) the transfer will result from federal-state cooperation in a subsidized-price-water economy. Vested and subsisting water rights should be identified. Future water needs of each region should be estimated and reserve allotments from water originating in each region should equal these needs. Water exceeding the reserve allotment should be available for export. Reserve and export allotments should be fixed for the term of amortization of diversion facilities. Priorities of use should be established. The point of diversion should be selected with regard to priorities and economic efficiency. Both original and delivery regions should practice water conservation. Legal impediments to water transfer should be ameliorated by the states. Regions of delivery should establish regional guarantee funds payable to the regions of origin on the occurrence of new water needs. New allotments and priorities should be determined prior to the end of the established allotment term. The system should be implemented both between the states and under the aegis of the federal government. (Dye-Florida)
W70-06306

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT,'
Michael V. McIntire.
Land and Water Law Review, Vol 5, No 1, p 23-48, 1970. 26 p, 91 ref.

Descriptors: *Wyoming, *Water rights, *Prior appropriation, *Adjudication procedure, Appropriation preferences (Water rights), Competing uses, Irrigation, Non-structural alternatives, Regulation, Relative rights, Water allocation (Policy), Water contracts, Water law, Water utilization, Diversion, Water permits, Withdrawal, Irrigation water, Water users, Water demand.

The appropriation system of water rights in Wyoming has been ineffective in large part because of inaccurate records that do not reflect actual water practices in the state. Many of the reasons for the discrepancies are described, along with the consequences that inaccurate records impose on the state and on the holders of water rights. A number of failures in the current scheme are disclosed and a number of possible changes in water law and policy are pointed to. Three solutions are outlined, along with the possible problems, advantages and disadvantages of each. Some administrative changes are recommended, and a method of financing the schemes is suggested. (See also W70-06308 thru W70-06310). (Douberley-Florida)
W70-06307

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT.' (THE EXTENT OF THE PROBLEM),
Michael V. McIntire.
Land and Water Law Review, Vol 5, No 1, p 23-30, 1970. 7 p, 34 ref.

Descriptors: *Wyoming, *Water permits, *Water users, Preferences (Water rights), Water rights, Adjudication procedure, Appropriation, Prior appropriation, Administrative agencies, Competing uses, Irrigated land, Irrigation, Regulation, Relative rights, Water allocation (Policy), Water contracts, Consumptive use, Diversion, Use rates, Withdrawal, Irrigation water, Riparian rights, Usufructuary right.

Water rights in Wyoming have been granted upon proofs submitted by users which contain information concerning the nature and the extent of the use. These records are an inaccurate reflection of actual water use because of inaccuracies in filings and subsequent unrecorded changes in use. The State Engineer has been unable to eliminate unused water rights, and there exists the possibility of the resurrection of an unused right which might affect the source of water for the owner of a subsequent right. Under the appropriation system, early priority rights are protected, so the holder of a water right remains uncertain of his actual rights. This uncertainty discourages new development, precludes an effective state water plan, and affects dealings with other states and the federal government. Discrepancies in the record result from insufficient water to irrigate the lands described, and practice of irrigating less land than the records show, inaccuracies in land description and in descriptions of the nature of the use, and inaccurate descriptions of points of diversion. (Douberley-Florida)
W70-06308

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT.' (ANALYSIS OF THE PROBLEM AND CRITERIA FOR A SOLUTION),
Michael V. McIntire.
Land and Water Law Review, Vol 5, No 1, p 30-37, 1970. 7 p, 34 ref.

Descriptors: *Wyoming, *Water rights, *Water allocation (Policy), *Water permits, adjudication procedure, Appropriation, Preferences (Water rights), Prior appropriation, Administrative agencies, Competing uses, Non-structural alternatives, Regulated flow, Regulation, Relative rights, Water law, Non-consumptive use, Consumptive use, Recreation, Beneficial use, Construction, Water demand, Groundwater, Surface-groundwater relationships, Usufructuary right.
Identifiers: Abandonment (Water rights).

Many discrepancies in the Wyoming water use records are the result of users over-estimating the amount of land to be irrigated. The legislature has failed to provide the State Engineer with adequate funds or personnel to enforce water rights or with workable enforcement procedures. Abandonment proceedings for unused rights are complicated and expensive. Detections of water use violations are difficult, and sanctions are ineffective. Unconstructed permits present problems because they allow the permittee to delay completion of construction and still take advantage of the early priority of his original permit. Maintaining accurate records of water users and water rights requires bringing the records and water use patterns into harmoney, devising ways of maintaining accurate records, and delineating the purpose and goals of water law in light of changing needs. Water laws must change to meet changes in the population and economics. Limitations on water rights may have to vary with the use and the place of the use. The concept of beneficial use may be expanded to include non-consumptive and recreational uses. Correlation of surface and groundwater rights may be necessary. (Douberly-Florida)
W70-06309

THE DISPARITY BETWEEN STATE WATER RIGHTS RECORDS AND ACTUAL WATER USE PATTERNS 'I WONDER WHERE THE WATER WENT.' (POSSIBLE SOLUTIONS),
Michael V. McIntire.
Land and Water Law Review, Vol 5, No 1, p 37-48, 1970. 11 p, 22 ref.

Descriptors: *Wyoming, *Water rights, *Adjudication procedure, *Water permits, Appropriation, Preferences (Water rights), Prescriptive rights, Prior appropriation, Administrative agencies, Competing uses, Equitable apportionment, Taxes, Non-structural alternatives, Regulated flow, Regulation, Water allocation (Policy), Water law, Water utilization, Non-consumptive use, Use rates, Water users, Water demand.

One solution to the Wyoming water use problem would require that appropriators conform water uses to those shown on existing records. It would probably require new legislation, although existing agencies arguably possess the requisite power now. Such a strict enforcement scheme would be met with legal obstacles of laches and estoppel, and it would have a disruptive social and economic impact by upsetting existing long-time water uses. A second solution would require that records be changed to conform to existing uses. A curative act would allow for validating currently unauthorized uses. Surveying water uses would be expensive and lengthy, and there is no provision for change. The third solution would ratify existing uses for a period of time with provisions for abandonment of unused rights. Water rights would be renewable, but subject to changing laws and conditions. For water law administration, the state needs more money, more personnel, and improved methods of obtaining water use data. The program could be financed through a water use tax in conjunction with a report filed by the user. (Douberley-Florida)
W70-06310

6F. Nonstructural Alternatives

FLOOD HAZARD INFORMATION, POTOMAC RIVER AND TRIBUTARY STREAMS, STAFFORD COUNTY, VIRGINIA.
Corps of Engineers, Baltimore, Md.
For primary bibliographic entry see Field 04A.
W70-05918

URBAN HYDROLOGY, STORM DRAINAGE, AND FLOOD PLAIN MANAGEMENT IN METROPOLITAN AREAS OF THE UNITED STATES,
American Public Works Association, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-05960

ZONING FOR FLOOD DAMAGE MITIGATION,
New South Wales Univ., Kensington (Australia).
C. H. Munro.
New South Wales University Water Research Laboratory Technical Report No 69/2, Janaury 1969. 10 p, 1 tab.

Descriptors: *Flood plain zoning, *Economics, *Flood damage, Costs, Flood proctection, Nonstructural alternatives, River basin development, Water resources development.
Identifiers: Liverpool (Australia), New South Wales.

If residential development is permitted on all lots in the area under consideration in Liverpool, New South Wales, Australia which are above the flood level of 20 year recurrence interval, the average annual damage of houses in the lowest level in the area will approximate $15.00 per annum per house in 1968 money values. Obviously a prospective home buyer would much prefer to bear this small cost in order to live in an area close to the thriving commercial center of Liverpool, with all its desirable amenities of schools, hospitals, transport system, shopping centers and the like, rather than to be forced to go to areas more distant from these facilities. In the Town Plan of the Liverpool City Council, residential development should be permitted on all land which is not flooded by the flood of 20 years recurrence interval. (Knapp-USGS)
W70-06146

FLOOD WARNING BENEFIT EVALUATION - SUSQUEHANNA RIVER BASIN (URBAN RESIDENCES),
Weather Bureau, Silver Spring, Md. Office of Hydrology.
Harold J. Day.
ESSA Technical Memorandum WBTM HYRO 10, March, 1970. 42 p, 5 tab, 12 fig, 15 ref, 2 append.

Descriptors: *Flood damage, Evaluation, Flood proofing, Flood plains, Warning systems, *Nonstructural alternatives.
Identifiers: *Flood warnings, *Susquehanna River Basin, Evacuation.

The effectiveness of a warning service, in urban areas only, coupled with either temporary flood proofing or evacuation of residential structures in reducing flood damage, is the subject of this report. Communities in the floodplain of the Susquehanna River Basin in New York, Pennsylvania, and Maryland were used for a computer simulation of flood-related action. For the 116 reaches of the river system investigated, flood damage to residences - without any warning- was estimated to be No. 3 million (expected annual cost). Reducible damages represented one-third of this value $1 million. Reliable warnings, allowing 6 to 12 hours of action time, could be expected to provide at least two-thirds of the reducible damage as net benefits. Evacuation was generally economically advantageous compared to temporary flood proofing. Efficient local disaster organizations and total public response and compliance with action decisions are assumed. Loss of life has not been included. (Stahl-ESSA)
W70-06182

6G. Ecologic Impact of Water Development

FERTILITY OF THE BURBOT (LOTA LOTA L.) IN RYBINSK RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Narragansett, R.I. Narragansett Marine Game Fish Research Lab.
V. M. Volodin.
Translation of the Narragansett Marine Game Fish Research Laboratory, Bureau of Sports Fisheries. Available from the Clearinghouse as PB-189 284T, $3 in paper copy, 65 cents in microfiche. In: Akademiya Nauk, SSR, Institut Biologii vnutrennikh vod, trudy, no 17-20, Nauka, 1969, pp 222-229.

Descriptors: *Fish behavior, Fertilization, Aquatic habitats, Fish farming, Reservoir operation.
Identifiers: *Burbot (Lota Lota L.).

The absolute fertility of the burbot, as well as many other species of fish, grows regularly with increase in the sizes of fish; at the same time the relative fertility depends little on the size of fish, at least a correlative connection between these characters was not established for the Rybinsk population. Both the absolute and relative fertility of equal-size individuals of the burbot vary extremely, in which the difference in the extreme values can be very great. The average fertility of a group of equal-size individuals is not a constant quantity and changes from year to year. Fertility is deeply connected with the conditions of existence of the fish. Size of the eggs practically does not depend on the size of the fish, however, the fluid content of the egg increases somewhat with increase of the absolute fertility. The diameter of the egg remains unchanged with increase of relative fertility, but the weight of the egg decreases regularly; this decrease occurs due to decline in the amount of yolk in the eggs, whereas the relative amount of water in it remains constant.
W70-05974

THE DELAWARE VALLEY ENVIRONMENT: STATUS AND PROSPECTS.
Greater Philadelphia Chamber of Commerce, Pa.; and University City Science Center and Inst., Philadelphia, Pa.

Earth Week Technical Symposium held in Philadelphia, Pennsylvania, April 4-10, 1970. 184 p, 4 fig, 24 tab, 108 ref.

Descriptors: *Water pollution effects, *Water pollution control, *Air pollution, *Environmental effects, *Urbanization, Ecology, Environment, Delaware River, Waste disposal, Radioactivity, Systems analysis, Planning, Water law, Legislation, Social aspects, Population, Human population.
Identifiers: Delaware River Basin.

A Technical Symposium was held in conjunction with the activities sponsored by the Earth Week Committee of Philadelphia. Seeking a dramatic impact on the environmental conscience of the nation, a prime purpose of the nationwide Earth Week effort is to arouse public opinion on necessary steps to protect out environment. To achieve this goal of education these technical symposia brought together experts on environmental matters from universities, government, and the corporate community in the Philadelphia Region. One key purpose was to develop an inventory and status report on environmental problems in the Philadelphia or Delaware Valley Region. Emphasis was placed on the interrelationships and interdependencies among environmental problems, particularly because the focus of discussions is a major metropolitan area with an enormous range of environmental interactions. (Knapp-USGS)
W70-06101

ECOLOGICAL IMPLICATIONS OF RIPARIAN VEGETATION MANAGEMENT,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W70-06103

DISTINCTIVE ASPECTS OF THE ECOLOGY OF STREAM FISHES: A REVIEW,
Fisheries Research Board of Canada, Nanaimo (British Columbia). Biological Station.
K. Radway Allen.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1429-1438, 1969. 1 fig, 17 ref.

Descriptors: *Fish, *Streams, *Ecology, Fish behavior, Food habits, Streamflow, Fish reproduction, Metabolism, Reviews.
Identifiers: Trout zone, Grayling zone, Barbel zone, Bream zone, Salmo trutta, Thymallus thymallus, Barbus barbus, Abramis brama, Fish fauna, Rapid streams, Fish social behavior.

In descending order of average current velocity, streams have been divided by Huet into four zones: trout, grayling, barbel and bream. Classification of North American streams (Lagler) has resulted in five similar zones. Such classifications often confuse or ignore such effects as climate, distribution and environmental requirements. Characteristics of fish inhabiting the trout and grayling zones are considered exclusively. Such fish have higher oxygen requirements and concomitant high lower lethal oxygen limits. They tend to have either streamlined or flattened body shapes which allow for maintenance of position in the current. Reproduction involves burying eggs in the stream bed, with or without definite nest-building. Principal dietary components are bottom aunan, small fishes and autochthonous and allochthonous drift. For the most part, such fishes are solitary and sometimes strongly territorial; schooling behavior is rare. A notable exception is the Japanese ayu, Plecoglossus altivelis, which feeds on attached algae and exhibits schooling behavior when population densities rise above a critical level. (Voigtlander-Wisconsin)
W70-06220

SOME EFFECTS OF THE KISSIMMEE RIVER CHANNELIZATION ON THE FISHERY RESOURCE,
For primary bibliographic entry see Field 05C.
W70-06287

07. RESOURCES DATA

7A. Network Design

DEEDS AND DATA,
For primary bibliographic entry see Field 05D.
W70-06078

ANALYSIS OF A 24-YEAR PHOTOGRAPHIC RECORD OF NISQUALLY GLACIER, MOUNT RAINIER NATIONAL PARK, WASHINGTON,
Geological Survey, Washington, D.C.
Fred M. Veatch.
Report for sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Geological Survey Professional Paper 631, 1969. 52 p, 39 fig, 1 plate, 1 tab, 13 ref.

Descriptors: *Glaciers, *Surveys, *Photography, *Washington, Mapping, Terrain analysis, Geomorphology, Melting, Regimen, Movement, Scour, Snowpacks, Glaciation, Data collections.
Identifiers: Nisqually Glacier, Mount Rainier.

A systematic coverage of Nisqually Glacier by photographs taken from a network of stations on the ground was begun in 1942 to explore the value and limitations of such photographs as an aid in glacier study. Nisqually Glacier in Mount Rainier National Park, Wash., covers 2.5 square miles (1961) and extends from an altitude of about 14,300 feet near the top of Mount Rainier down to 4,700 feet in a horizontal distance of 4.1 miles. Photographs illustrating the retreat and advance of the glacier's west ice margin in a reach extending for about a mile downstream from Wilson Glacier show that, by 1965, most of the ice thickness lost in that area between 1890 and 1944 had been recovered. Year-to-year variations in the surface slope and other characteristics from place to place along the glacier are portrayed by pictures to a degree not economically attainable by any other means. Medial moraines and other persistent patterns sometimes overlooked in the field are more noticeable in photographs. Ice-cored moraines and patterns of multiple lateral moraines are visible. Effects of the 1932 and 1955 outburst floods on the stream channel and trees for a mile or so below the glacier are shown. Some photographic procedures recommended for use in a program of this type are described. (Knapp-USGS)
W70-06143

7B. Data Acquisition

WATERSHED HYDRAULICS IN THE LABORATORY,
Missouri Univ., Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-05920

THE THERMOMETRICAL METHODS OF STUDYING GROUNDWATER,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 02F.
W70-05938

A METHOD OF DETERMINATION OF THE INTENSITY OF A STREAM MACROTURBULENCE THROUGH APPLICATION OF A THERMISTOR,
Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.
E. Masiar.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B28, p 237-248, 1967. 12 p, 12 fig, 1 ref.

Descriptors: *Instrumentation, *Flowmeters, *Turbulence, *Vortices, Flow measurement, Turbulent flow, Thermometers, Heat transfer, Calibrations, Anemometers.
Identifiers: Macroturbulence measurement, Thermistors.

Turbulence measurements were made with a thermistor to evaluate the intensity of turbulence on the basis of the line of so-called 'instantaneous' velocities of a turbulent water stream or on the basis of the corresponding line of the time current course. The advantages of the new method are the speed and accuracy of measurements as well as the possibility of evaluating the intensity of macroturbulence at single points. (Knapp-USGS)
W70-05950

THE STEADY STATE AND DYNAMIC HEAT TRANSFER FROM TURBULENCE SENSORS IN LIQUIDS,
Purdue Univ., Lafayette, Ind.; and Tennessee Technological Univ., Cookeville.
J. W. Delleur, G. H. Toebes, and C. L. Liu.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B27, p 227-236, 1967. 10 p, 6 fig, 2 tab, 7 ref.

Descriptors: *Model studies, *Hydraulic models, *Instrumentation, *Open channel flow, *Turbulent flow, Heat transfer, Thermometers, Flow measurement, Calibrations, Anemometers, Flowmeters.
Identifiers: Turbulence measurement, Hot-wire anemometers.

The measurement of turbulence parameters in liquid flows is becoming increasingly important. The adequacy and potential of possible transducer systems are poorly known. Among the several possible systems two cylindrical sensors, the hot-wire and the cylindrical hot-film, are studied. Steady state heat transfers from Hytemco wire and from quartz-coated cylindrical-platinum film in water and in aqueous solutions of ethylene glycol were measured. Experiments were made in a rotating vessel which provided a flow field of controllable fluid velocity, temperature and composition. This heat transfer may be predicted with reasonable accuracy by Kramers' formula, which may also be used with confidence for analytical purposes, but is not intended to replace calibration procedures. The amplitude and phase frequency response of the anemometers were obtained by oscillating the sensors along the axis and in the potential core of a submerged water jet. The amplitude-frequency response was found to be nearly constant within the tested range of 2 to 38 cycles per second. The phase shift was found to be less than 10 deg on the average for frequencies between 10 and 38 cps and averaged approximately 20 deg below 10 cps. The equipment and the method of system evaluation are probably adequate for turbulence measurement in water, because most of the turbulence energy is found below 50 cps in usual hydraulic flow fields. (Knapp-USGS)
W70-05952

THEORETICAL ASPECTS OF THE COMPARABILITY OF PRODUCTIVITY DATA,
Freshwater Biological Association, Wareham (England). River Lab.
D. F. Westlake.
Proceedings of the International Biological Program Symposium on Primary Productivity in Aquatic Environments, Pallanza, Italy, April 1965. Memorie dell'Istituto Italiano di Idrobiologia, 18 Supplement, p 313-322, 1965. 9 ref.

Descriptors: *Classification, *Productivity, *Biomass, Bioassay, Energy, Primary productivity, Methodology, Biology, Theoretical analysis.
Identifiers: *Definitions, *Terminology, International Biological Program, Criteria.

In view of the aim of International Biological Program to obtain internationally comparable observations of basic biological parameters, standard terminology, criteria, units of measure, and methodology are proposed for investigations of primary production in aquatic ecosystems. Defined terminology includes biomass, primary production, primary productivity, gross and net productivity, standing crop, crop and yield. For productivity and biomass, the use of organic dry weight as the primary criterion is suggested. Measurements should be made by most accurate method available, then converted to the acceptable criterion. Use of sequences of conversion factors should be avoided. Preferred units of biomass are kilogram (kg) per square meter or grams per square meter; for productivity, grams per square meter per day or metric tons per hectare per year; for irradiance, gram-calories per square centimeter per minute or watts per square centimeter. per minute or watts per square centimeter. When energy-flow data are presented on a hectare-year basis, the standard nutritional unit 10 (to the sixth power kg cal) is suggested. A discussion of some problems involving methods and conversions is given, centering around measurements of biomass and productivity in typical two-layered aquatic systems. (Voigtlander-Wisconsin)
W70-05978

THE SOLUBILITY OF OXYGEN IN WINKLER REAGENTS USED FOR THE DETERMINATION OF DISSOLVED OXYGEN,
Liverpool Univ. (England). Dept. of Oceanography.
C. N. Murray, J. P. Riley, and T. R. S. Wilson.
DeepSea Research, Vol 15, p 237-238, 1968. 9 ref.

Descriptors: *Oxygen, *Analytical techniques, *Solubility, *Dissolved oxygen, Sea water, Technology, Application methods, Chemical reactions, Physical properties, Methodology.
Identifiers: *Winkler reagents, *Determination, Errors.

Although the Winkler method has been used for oxygen determination in sea water over 75 years, little has been done to measure the error produced by dissolved oxygen introduced with the two reagents. While this error is negligible for routine purposes, which Carpenter estimated at 0.018 milliliters/liter, in precision work, such as measurement of oxygen solubility, it may considerably exceed the experimental error. Attempts to determine the solubility of oxygen in Winkler reagents by both physical and chemical methods is described. A modification of the procedure followed by Ben Naim and Baer was used for the physical measurements and the error estimated as 0.012 milliliters/liter. Failure to make this correction would produce a positive error of about 0.24% for sea water at 20C. The chemical determination of the amount of oxygen added with the Winkler reagents indicated that use of 1 milliliter of each Winkler reagent in a determination carried out in a 140 milliliter flask produces an error of 0.011 milliliters/liter, a figure in excellent agreement with that found physically. (Jones-Wisconsin)
W70-05996

THE QUESTION OF MEASURING AVERAGE VELOCITY RATE IN PIPES BY MEANS OF POINT-TYPE SENSORS,
Foreign Technology Div., Wright AFB, Ohio.
For primary bibliographic entry see Field 08A.
W70-06031

PROVISIONAL TIME-OF-TRAVEL FOR ILLINOIS STREAMS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02E.
W70-06035

APPLICATION OF ELECTRIC WELL LOGGING AND OTHER WELL LOGGING METHODS IN HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02F.
W70-06098

SOME EXPERIMENTS WITH THE HOT-FILM ANEMOMETER IN WATER,
Queen's Univ., Belfast (North Ireland). Dept. of Civil Engineering.
R. H. J. Sellin.
Journal of Hydraulic Research, Vol 8, No 1, p 71-88, 1970. 18 p, 6 fig, 7 ref.

Descriptors: *Anemometers, *Flowmeters, *Turbulent flow, *Eddies, Vortices, Turbulence, Instrumentation, Currents (Water), Statistical methods, Calibrations.
Identifiers: Hot-film anemometer.

These experiments were made with a concial shaped hot-film probe used in conjunction with a constant temperature bridge. The probe was mounted at the end of a rotating arm installed in a tank of water. The water was set into a random turbulent motion by means of a reciprocating grid-like plunger driven vertically close to the base of the tank. A statistical analysis of calibration data is presented together with an assessment of the repeatability of r.m.s. measurements, based on standard deviations. The angle of inclination between the probe axis and the local mean flow direction was varied and is shown to have an effect on the turbulence measurements recorded. Finally the frequency spectra are obtained for this type of turbulence and shown to be closely similar to those obtained for isotropic turbulence. (Knapp-USGS)
W70-06104

METEOROLOGICAL SATELLITE VIEWS OF CLOUD GROWTH ASSOCIATED WITH THE DEVELOPMENT OF SECONDARY CYCLONES,
National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center.
William E. Shenk.
Report available for sale by Clearinghouse, Springfield, Va. - Price $3.00. National Aeronautics and Space Administration Technical Note TN D-5680, April 1970. 24 p, 28 fig, 2 tab, 6 ref.

Descriptors: *Remote sensing, *Meteorology, *Satellites (Artificial), *Cyclones, Synoptic analysis, Climatology, Weather data, Solar radiation, Fronts (Atmospheric), Storm structure, Weather patterns.
Identifiers: Secondary cyclones, TIROS IV, Radiometry.

During March 1962 the cloud changes associated with the predevelopment and development periods of two secondary cyclones in the North Pacific Ocean were viewed on at least two successive days by the 8- 12 micron 'window' channel of the TIROS IV meteorological satellite. Both secondary cyclones developed at the base of the occlusion. For the two cases, when the secondary circulations were first noticeable on the surface chart, the equivalent blackbody temperatures, T (BB), as measured by the radiometer averaged 15 deg K colder than the day before in the northeast quadrant relative to the base of the occlusion. The average T (BB) was taken over an area of approximately 300,000 square miles. For two other cases, an average warming of 4 deg K occurred from day to day over the same area relative to the base of the occlusion when no significant secondary development occurred and when the primary occluded cyclone was slowly weakening. These results suggest that, with the assistance of meteorological satellite radiation data, considerable cloud growth is noticeable prior to the generation of a secondary cyclone at the base of the occlusion. (Knapp-USGS)
W70-06127

PERCEPTION VIA SATELLITE,
Department of the Interior, Washington, D.C. Earth Resources Observation Satellite Program.
Charles J. Robinove.
Water Spectrum, Vol 2, No 1, p 14-19, Spring 1970. 6 p, 5 fig.

Descriptors: *Remote sensing, *Satellites (Artificial), Telemetry, Hydrologic data, Data collections, Surveys, Investigations, Aerial photography, Photogrammetry, Radar, Photography, Mapping.
Identifiers: Hydrologic remote sensing.

The Earth Resources Observation Satellite (EROS) Program in the Department of the Interior is intended to gather and use data from satellites and aircraft on natural and man-made features of the earth's surface. Earth Resources Technology Satellite will provide the EROS Program with data for use in dealing with natural resource problems and understanding the interaction between man and the environment. Applications will include studies of tectonic features, hydrologic problems, location of fish schools, determination of the conditions of range land, mapping land use for urban planning, studies of erosion and change along coastlines and major streams, and inventories of land use and land forms. In addition, the ERTS data may be used for detecting forest and crop diseases and inventorying crops. The ERTS satellite will be in a polar, sun-synchronous orbit so that each point on the earth's surface will be sensed every 17 to 20 days, at the same time of day. Multispectral photography is being investigated for its usefulness in hydrology. Side-looking airborne radar has not yet been widely used in hydrologic studies, although it is an excellent tool for all-weather, day or night, coverage of large areas. Other techniques being investigated include passive microwave radiometry, ultraviolet and visible stimulated luminescence, and absorption spectroscopy. (Knapp-USGS)
W70-06136

INDIRECT SENSING OF ATMOSPHERIC WATER VAPOR,
Barney J. Conrath.
In: Significant Accomplishments in Science, National Aeronautics and Space Admin Special Publication NASA SP-195, Proceedings of Symposium, Goddard Space Flight Center, Jan 10, 1969, p 20-22. 3 p. 2 fig.

Descriptors: *Water vapor, *Remote sensing, *Meteoric water, *Methodology, *Analytical techniques, Extraterrestrial hydrology, Satellites (Artificial), Atmospheric physics, Infrared radiation, Absorption, Temperature, Humidity.
Identifiers: *Atmospheric water vapor, Satellite-borne sensors, Nimbus B2.

Methods are briefly described of investigating water vapor from space using satellite-borne sensors to make in situ measurements. Analytical techniques are given for studying the vertical distribution of ozone and water vapor, gases which are optically active in the infrared. Basic principles are illustrated and results of an application to actual data obtained from infrared interferometer spectrometer sonde ascents are demonstrated. Infrared radiation intensity reaching a satellite-borne sensor in a narrow spectral band can be regarded as the weighted mean of the Planck intensities associated with the temperature at each level in the atmosphere. Computation methods are being developed, and data from Nimbus B2 satellite will allow testing the techniques on a global basis. (Lang-USGS)
W70-06159

OPTICAL METHOD FOR EXPERIMENTAL STUDIES ON TURBULENT FLOWS,
Vsesoyuznyi Nauchno Issledovatelskii Institut Gidrotekhniki, Leningrad (USSR).
M. W. Pechenkin.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B26, p 218-226, 1967. 9 p, 4 fig, 1 tab, 3 ref.

Descriptors: *Model studies, *Hydraulic models, *Turbulent flow, Open channel flow, Closed conduit flow, Photography, Instrumentation.
Identifiers: Optical measurement.

The techniques and instrumentation used in experimental studies of turbulent flows are discussed. Data are given on the experimental hydraulic apparatus, photographic equipment with flash tubes and the arrangement for picture treatment. The same techniques are extended to two-phase flows. For this purpose transparent materials with identical-refractive indices are employed for both the supporting fluid and the suspended matter. (Knapp-USGS)
W70-06174

7C. Evaluation, Processing and Publication

COLOR OF WATER IN FLORIDA STREAMS AND CANALS,
Geological Survey, Tallahassee, Fla.
Matthew I. Kaufman.
Florida Bureau Geology Map Series No 35, 1969. 1 sheet, Text, 7 fig, 1 map, 3 tab, 12 ref.

Descriptors: *Florida, *Water quality, *Regional analysis, *Color, *Decomposing organic matter, Organic acids, Swamps, Seasonal.
Identifiers: Water color-discharge relations, Chemical associations.

A 1-sheet atlas report of the occurrence and distribution of color in Florida streams includes sources, nature and significance, regional distribution and chemical associations, seasonal variations, and the relations of color to streamflow. Many of Florida's surface waters are highly colored, ranging form less than 100 units to greater than 500 units (platinum-cobalt scale). Broad regions of considerable color (300 to over 500 units) include northeast and northcentral Florida, where streams drain extensive swamplands and southeast Florida in the environs of Lake Okeechobee where canals drain intensively cultivated agricultural lands. Most of the highly colored streams in Florida have low specific conductance, are soft, acidic, and contain appreciable iron. The color is derived from the natural decomposition of organic matter and is associated with carbon dioxide and organic acids. Maximum color values predominate during July through October, coincident with the period of active decomposition and leaching of organic matter and the flush-action of high rainfall and runoff. (Kaufman-USGS)
W70-05931

QUANTITATIVE INTERPRETATION OF REGIONAL GROUNDWATER FLOW PATTERNS AS AN AID TO WATER BALANCE STUDIES,
Department of Energy, Mines and Resources, Calgary (Alberta).
For primary bibliographic entry see Field 02F.
W70-05932

ANALYSIS OF THE GROUNDWATER HYDROGRAPH,
For primary bibliographic entry see Field 02F.
W70-05936

MODELLING OF INFILTRATION PROCESS IN THE ANALOG COMPUTER,
Gidrometeorologicheskii Institut, Odessa (USSR).
For primary bibliographic entry see Field 2G.
W70-05941

RHEOELECTRIC ANALOGY; STUDY OF AN ARTESIAN BASIN, APPLICATION ON THE AR-

TESIAN GROUNDWATER OF THE 'SABLES INFERIEURS D'AQUITAINE' (IN FRENCH),
Bordeaux Univ. (France). Dept. of Hydrogeology.
For primary bibliographic entry see Field 02F.
W70-05945

ON THE TECHNIQUE FOR SOLVING HYDROGEOLOGICAL PROBLEMS USING SOLID AND NETWORK ELECTRIC MODELS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 02F.
W70-05946

A THREE PARAMETER DISTRIBUTION FOR PRECIPITATION DATA WITH A STRAIGHT-LINE PLOTTING METHOD,
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 02B.
W70-05961

LONGITUDINAL DISPERSION OF THE LOWER KANSAS RIVER BASIN,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02E.
W70-06096

A MULTIPLE REGRESSION TECHNIQUE FOR ADJUSTING BACKGROUND VALUES IN STREAM SEDIMENT GEOCHEMISTRY,
Pennsylvania State Univ., University Park. Mineral Conservation Section; and Pennsylvania State Univ., University Park. Dept. of Geochemistry and Mineralogy.
For primary bibliographic entry see Field 02K.
W70-06124

AN INVENTORY OF LARGE LAKES IN CALIFORNIA,
Geological Survey, Menlo Park, Calif. Water Resources Div.
For primary bibliographic entry see Field 02H.
W70-06149

EVALUATION OF A DIGITAL COMPUTER METHOD FOR ANALYSIS OF COMPARTMENTAL MODELS OF ECOLOGICAL SYSTEMS,
Colorado State Univ., Fort Collins. Coll. of Forestry and Natural Resources.
L. J. Bledsoe, and G. M. Van Dyne.
Oak Ridge National Laboratory, Tennessee, Health Physics Division, Radiation Ecology Section, ORNL-TM-2414, February 1969. 64 p. 7 fig, 7 tab, 8 ref, append A, B, C, D.

Descriptors: *Analytical techniques, *Digital computers, *Ecosystems, *Systems analysis, Computer models, Computer programs, Data processing, Leaching, Energy transfer, Mass transfer, Mathematical models, Simulation analysis, Planning, Stochastic processes, Statistical methods, Soil dynamics, Radioecology, Tracers, Radioactivity.
Identifiers: *Compartmental models, COMSYS2, FORTRAN IV, FORTRAN 63, CDC 6400, CDC 1604, IBM 360/75, IBM 7090, Differential equations, Forest litter, Statistical variability, Millipedes, Theoretical ecology, COMSYS2 (MOD 1), COMSYS2 (MOD 2), COMSYS1, Microcosms.

COMSYS2, a digital computer program, was developed for data analysis from studies in which ecosystems are represented by compartmental models wherein energy or matter flows between compartments. If flow between compartments is depicted by a set of linear, homogeneous differential equations, COMSYS2--accepting empirical data on contents of some or all compartments at a series of points in time--generates a matrix of coefficients for equations describing possible transfers within the ecosystem. COMSYS2 has been written in FORTRAN 63 for CDC 6400 and 1604 computers, and in FORTRAN IV for IBM 360/75 and 7090 systems. Real and synthetic data were used to test for type and convergence rate toward minimized sum of squared deviations between observed and predicted data points for each compartment. Synthetic data were generated with known degrees and types of errors so as to simulate variability normally encountered in biological systems. Results of computer simulations are tabulated and presented graphically, and listings of programs and subroutines, with directions for use, are appended. Generally, COMSYS2 performs well, but--with highly variable data--may not converge on true parameters practicably soon, and care must be exercised in selecting reasonably realistic initial values required by the program. (Eichhorn-Wisconsin)
W70-06231

THE MODIFICATION OF A PREDICTIVE RIVER BASIN MODEL,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 05G.
W70-06313

08. ENGINEERING WORKS

8A. Structures

INVESTIGATIONS OF VARIOUS SHAPES OF THE UPSTREAM QUADRANT OF THE CREST OF A HIGH SPILLWAY,
Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Div.
E. S. Melsheimer, and T. E. Murphy.
Corps of Engineers Research Report H-70-1, January 1970. 4 p, 16 plate.

Descriptors: *Open channel flow, *Spillway crests, *Hydraulics, Cavitation, Discharge (Water), Abutments, Spillways, Hydraulic structures, Aeration.
Identifiers: Spillway flow.

The effects shape of the upstream quadrant of the crest of a high spillway on water flow was studied. Tests involved determination of pressures and discharge coefficients, with and without crest piers, at heads varying from one-fourth the design head to one and one-half times the design head. Limiting conditions for cavitation on the crest are defined. For all crests the pressures at the crest line were essentially the same for equal discharges. The variations in minimum pressures occurred in dips in the pressure gradients on the upstream quadrant and thus apparently had no effect on the discharge coefficients. Pier contraction coefficients are sensitive to direction of approach flow, width of pier, and position of pier nose with respect to crest as well as pier-nose shape; thus it is hard to develop generalized data applicable to any particular set of conditions. Usually, structural considerations will result in crest piers sufficiently long to extend downstream of the subatmospheric pressure zone on the spillway crest; however, care should be taken to see that this always is true. If the downstream end of the pier is located within the subatmospheric zone, aeration of the spillway nappe is a possibility. This could result in a loss of capacity or, worse still, in an unstable nappe. (Knapp-USGS)
W70-05915

THE STRENGTH AND CREEP OF FROZEN SOILS AND CALCULATIONS FOR ICE-SOIL RETAINING STRUCTURES,
Cold Regions Research and Engineering Lab., Hanover, N.H.
For primary bibliographic entry see Field 08D.
W70-05968

THE QUESTION OF MEASURING AVERAGE VELOCITY RATE IN PIPES BY MEANS OF POINT-TYPE SENSORS,
Foreign Technology Div., Wright AFB, Ohio.
V. M. Kos, and Yu I. Sitniskiy.
Trans. of Kontrolno-Izemeritelnaya Tekhnika (USSR) No. 4, p. 123-126, 1968, Available from the Clearinghouse as AD-700 368, $3.00 in paper copy, $0.65 in microfiche. Translation No. FTD-HT-23-420-69, Sept. 18, 1969, 9 p. 3 refs.

Descriptors: *Flow rates, *Turbulent flow, *Pipe flow, Pipes, Average flow, *Flow measurement.

Assuming that the rates of flow are symmetrically distributed with respect to the pipe axis, the location of a layer is found in which the flow rate is equal to the average flow rate of the fluid in the pipe; the variation of this location with the varying average rate is investigated. Experimental curves of rate versus radius are shown. These curves are described by an exponential equation. Examination of this equation shows that the measurement of the average rate by a point-type sensor placed in the average-rate layer is much more accurate than the measurement of the maximum rate with subsequent rate correction. The theoretical error of measurement when the point sensor is displaced from its true average-layer position by 1 percent is 0.15 percent. However, the practical value of this error will be somewhat higher.
W70-06031

OCEAN ENVIRONMENT AND DESIGN CONSIDERATIONS IN A PRERECONNAISSANCE STUDY OF A CALIFORNIA UNDERSEA AQUEDUCT,
Litton Systems, Inc., El Segundo, Calif. Advanced Marine Technology Div.
Fred C. Lee.
For the Bureau of Reclamation. Available from the Clearinghouse as PB-189 110, $3.00 in paper copy, $0.65 in microfiche. Report, 30 Jun 69, 94 p.

Descriptors: Water resources development, Marine geology, Aqueducts, Water supply, Pipelines, Continental shelf.

A planning study for the design of an undersea aqueduct system which will have an incremental capacity in the range of 2,000,000 to 3,500,000 acre-feet of water per year. Design parameters include: Pipe design considerations; (Pipe configurations and materials, status of data acquisition, design of filament-wound pipe, sections and joints, anchoring concepts, materials testing), Construction and operation and maintenance procedures; (Pipe manufacturing, design of marine system for installation and operation and maintenance), Surveys of the ocean environment; (Parameters of motion, bathymetry, geology/soil mechanics, fouling studies); Materials, selection and testing; Primary definition of optimal construction and operation and maintenance configuration; Preliminary program cost estimate for reconnaissance study.
W70-06032

OBJECTIVE DETERMINATION OF SAFETY FACTOR IN RESERVOIR DESIGN,
Geological Survey, Washington, D.C.; Geological Survey, Fort Collins, Colo.; and Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
Edward R. Close, Leo R. Beard, and David R. Dawdy.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7297, p 1167-1177, May 1970. 11 p, 12 fig, 2 tab, 3 ref.

Descriptors: *Reservoir design, *Cost-benefit analysis, *Optimization, *Simulation analysis, *Safety factors, Statistical models, Systems analysis, Hydrology, Probability, Sampling, Streamflow forecasting, Economics, Project planning, Water resources development, Design criteria.
Identifiers: Hydrologic safety factor.

Objective criteria for determining hydrologic safety factor for reservoir design are developed for streamflow sample sizes of 10 yr, 25 yr and 100 yr. For the smaller sample sizes, the index of allowable shortages, for which average net benefits are max-

imum, is also smaller. This reduction in the index of allowable shortages results in an increase in the average reservoir size needed to offset the effects of sampling error. Thus, by varying the index of allowable shortages on the basis of hydrologic record length, safety factors may be determined. (Knapp-USGS)
W70-06111

PREVENTION OF SCOUR AT BRIDGE ABUTMENTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
John B. Herbich.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B9, p 74-87, 1967. 14 p, 11 fig, 19 ref.

Descriptors: *Scour, *Alluvial channels, *Bridges, Stream erosion, Erosion control, Bed load, Sediment transport, Floods, Model studies, Hydraulic models, Hydraulics.
Identifiers: Bridge abutments.

Many highway and railroad bridges fail during floods. The failure in many instances is attributed to local scour of river bed and subsequent failure of abutments. Spur dikes extending upstream from the abutments, in providing a smooth transition for the flow, were found to be extremely effective in reducing scour at the abutments. Studies which were conducted on both the fixed-bed and movable-bed model included variations in the percentages in waterway opening, dike angle with abutment and dike shape to a minor extent. The percentage waterway openings were selected to provide overlapping of scour patterns from each abutment. Two bridge crossings were considered; at 90-deg and at 60-deg to the direction of flow. (Knapp-USGS)
W70-06166

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, SUMMARY REPORT.
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06185

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME I - TEXT.
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06186

METROPOLITAN WATER REQUIREMENTS AND RESOURCES, 1968-2010, VOLUME II - TECHNICAL APPENDICES.
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06D.
W70-06187

PLANNING PROGRAM (1969).
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 06B.
W70-06188

EVALUATION OF REINFORCED PLASTIC MORTAR PIPE FOR WATER RESOURCES APPLICATIONS--A PROGRESS REPORT,
Bureau of Reclamation, Denver, Colo.
L. O. Timblin, Jr., and C. E. Selander.
Paper, Amer. Soc. Civ. Eng. Irrig. Drain Div. Conf, Austin, Tex., Nov. 1969. 37 p, 17 fig, 6 ref.

Descriptors: *Water pipes, Water supply systems, *Sewers, *Pipelines, Pipes, Composite materials, Sands, Glass fibers, *Plastic pipes, Field tests, Filaments, Laboratory tests, Research and development, Physical properties, Mechanical properties, Deformation, *Pressure pipes, Creep, Stiffness, Durability, Scaling, Fatigue (Mechanics), Environmental tests.
Identifiers: *Reinforced plastic mortar pipe, *Pipe tests, Polyesters, Glass reinforced plastics, Filament-wound construction, Pipe joints.

Reinforced Plastic Mortar (RPM) pipe was developed as a high-quality pipe to compete as an alternate to conventional water pipes such as cement asbestos, concrete, and steel. A Government-industry cooperative study of RPM pipe was initiated with the objective of generating sufficient performance data and knowledge to permit preparation of Bureau of Reclamation specifications for obtaining reliable pipe. Laboratory tests were designed to: (1) evaluate changes in physical properties after environmental exposure, (2) determine if performance of large-diameter pipe can be correlated to performance of small-diameter pipe by scaling factors, and (3) relate stiffness data for various classes of RPM pipe. Tests were also made to determine deformation of RPM pipe buried in compacted soil and under external load. Field studies included tests on a 15-in.-dia pipe in a test section in the Westlands Irrigation District, Calif, and a 39-in.-dia pipe in the Lower Yellowstone Irrigation District, Mont. Results to date show that performance is as expected, and if present trends continue, RPM pipe eventually may be specified as an alternate to other types of water pipe. (USBR)
W70-06246

RIVER DIVERSION AND CLOSURE,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
I. C. Dirom.
Engineering Journal, Canada, Vol. 52, No. 10, p. 57-60, Oct. 1969. 4 p, 6 fig, 1 ref.

Descriptors: *Diversion, Diversion structures, Diversion works, Tunnel construction, *Diversion tunnels, Tunnel design, Tunneling, *Scheduling, Tunnel linings, *River closures, Flow control, Performance, Stop logs, Outlet works, Foreign construction.
Identifiers: Closures, Tunnel inverts, Outlet tunnels, *W A C Bennett Dam (Canada), Construction methods, Stage construction.

Diversion facilities for W A C Bennett Dam consisted of a 140-ft-high cofferdam and three 48-ft horse shoe-shaped, concrete-lined tunnels, each approximately one-half mile long, located in the right abutment. The tunnels were designed to pass a flood flow of 270,000 cfs, having an estimated 15-yr frequency. Because of large ice flows and floating debris, the tunnels were designed for free flow up to the peak discharge. A reduction in the tunnel cross-sectional area was achieved by steepening the tunnel invert at the entrance to accelerate the flow. The tunnels operated successfully, passing ice, debris, and a record flood flow of 311,000 cfs without flowing full. Complex scheduling and a stage construction program for converting the tunnels to low level outlets while still required for diversion are described. (USBR)
W70-06248

PENSTOCK STEEL LINER--DESIGN AGAINST EXTERNAL PRESSURE,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
H. Lauga.
Engineering Journal Canada, Vol 52, No 10, p 43-46, Oct 1969. 4 p, 2 graph, 2 tab, 4 ref.

Descriptors: *Penstocks, *Steel linings, External forces, Design, *Buckling, Hydrostatic pressure, Steel pipes, Graphical analysis, Safety factors, Deformation, Bracings, Pressure tunnels, Theory, Foreign design practices, Grouting, Pressure conduits, Pressure pipes.
Identifiers: Portage Mountain Powerplan (Canada), Grouting pressure, Comparative studies, Pressure shafts.

A method for determining the critical buckling pressure for circular steel linings in underground shafts subject to external pressure is presented. The method, used in designing the penstocks for Portage Mountain Powerplant, Canada, was developed because of inconsistencies in available methods and to establish means for taking into account fabrication and construction tolerances. For many given sets of conditions, the critical buckling pressure, or a fairly narrow range of possible critical buckling pressures, can be determined with reasonable accuracy. The method will be a useful tool for determining appropriate pressures for contact grouting. Construction of a graph used to determine the effect of out-of-roundness for the Portage Mountain penstocks is described. Theories of critical buckling of steel pipes in a confined space developed by Amstutz, Borot, and Vaughan are discussed. (USBR)
W70-06249

W A C BENNETT DAM,
International Power and Engineering Consultants Ltd, Vancouver (British Columbia).
For primary bibliographic entry see Field 08D.
W70-06250

THE USE OF MODEL TESTS IN THE DETERMINATION OF THE SAFETY FACTOR IN ARCH DAMS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
Manuel Rocha, A. F. da Silveira, and Maria Cruz Azevedo.
Water Power, Vol 21, No 12, p 461-465, Dec 1969. 5 p, 10 fig, 2 tab, 4 ref.

Descriptors: Concrete dams, *Arch dams, Dam design, Dams, Compressive strength, Model studies, *Model tests, *Safety factors, Design criteria, Plastic deformation, Stress, Strain, Foreign research.
Identifiers: Concrete properties, Allowable stress, Similitude, Design practices, Compressive stress, Foreign testing, Portugal.

Concepts of safety in concrete arch dams are discussed and model tests to determine safety factors with respect to concrete strength are described. Numerous studies on dams having different characteristics disclose extremely high safety factors with respect to concrete strength, and show the marked influence of concrete plastification on these values. Design values for allowable compressive stress in concrete arch dams can be increased substantially without changing typical concrete strengths. Similitude requirements between the models and prototypes are discussed. (USBR)
W70-06254

CONSTRUCTION SAFETY--THE CHALLENGE OF THE '70'S,
Bureau of Reclamation, Denver, Colo.
Howard S. Latham.
Paper, Reg Safety Constr Eng Conf, Boise, Idaho, Jan 1970. 18 p.

Descriptors: *Construction, *Safety, Accidents, Training, Future planning (Projected), Tangible benefits, Insurance costs, Legislation, Health, Codes, Education, Standards, Failures, Statistics, Instruction, Responsibilities.
Identifiers: Injuries, Bureau of Reclamation, Enforcement, Health protection.

The construction industry has one of the highest injury rates, claiming an average of 2,600 lives and 250,000 disabling injuries per year. The principal cause of construction accidents has been inability to cope fully with the human element. A 4-yr study of accident causes throughout the Department of the Interior shows that 86% of all accidents involving use of construction equipment resulted from personal causes. The basic fault lies with the failure of management and labor to provide effective safety education and training. Experience shows that the Safety Training Course for Construction

Supervisors sponsored by the Associated General Contractors of America is an effective program. Because of the length and expense of the program, it is reaching only a few hundred people a year, when to be truly effective it should be reaching thousands. A program (based on the AGC course) planned by the Bureau of Reclamation with the aim of being made available to all contractor foremen on Bureau jobs is outlined. Safety records of Bureau of Reclamation contractors, safety records of the construction industry, and legislation aimed at improving construction safety are discussed. (USBR)
W70-06257

8B. Hydraulics

PATTERN OF POTENTIAL FLOW IN A FREE OVERFALL,
California Univ., Davis. Dept. of Water Science and Engineering; and Pahlavi Univ., Shiraz (Iran). Dept. of Engineering.
Theodor Strelkoff, and Mohammad S. Moayeri.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7207, p 879-901, April 1970. 23 p, 12 fig, 15 ref, append. OWRR Project B-037-CAL.

Descriptors: *Open channel flow, *Overfalls, Hydraulic structures, Hydraulics, Obstruction to flow, Mathematical studies, Jets.
Identifiers: Free overfalls.

A theory is presented to describe the two-dimensional flow of liquid in an open channel which terminates abruptly at a sharp drop. A dimensionless diagram expressing constancy of total head on the upper free surface is similar to the conventional specific-head versus depth and discharge versus depth diagrams. It is used to trace the course of the flow in the overfall. The ratio of free-surface-velocity magnitude to average horizontal component of velocity in the cross section is a decreasing function of distance in the direction of flow. The limiting case of the free overfall is at a Froude number approaching unity. A detailed description of the flow is given by an integral equation derived from conformal mapping and singularity distributions. Comparisons are made between the computed profiles and theoretical and experimental results of other investigators. (Knapp-USGS)
W70-05909

BRIDGE BACKWATER IN WIDE VALLEYS,
Arizona Univ., Tucson. Dept. of Civil Engineering; and Bureau of Public Roads, Washington, D.C.
Emmett M. Laursen.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY4, Paper 7246, p 1019-1038, April 1970. 20 p, 12 fig, 3 tab, 9 ref, append.

Descriptors: *Floods, *Bridges, *Backwater, Flow prodiles, Flood plains, Obstruction to flow, Streamflow.
Identifiers: Bridge backwater.

A method is presented for calculating the longitudinal water surface profile in the reach of a river in flood which is disturbed by the presence of the bridge and embankment fill. A variety of profiles is found to be possible depending on the abstraction or accretion rates and the resistance to flow. Because the flow on the floodplain is concentrated by the valley crossing, backwater is possible downstream from the bridge as well as upstream. (Knapp-USGS)
W70-05912

INVESTIGATIONS OF VARIOUS SHAPES OF THE UPSTREAM QUADRANT OF THE CREST OF A HIGH SPILLWAY,
Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Div.
For primary bibliographic entry see Field 08A.
W70-05915

RESULTS OF THE STUDY OF MACROTURBULENT MOVEMENT DOWNSTREAM OF A HYDRAULIC JUMP (IN FRENCH),
Institute of Hydrotechnical Research, Bucharest (Rumania). Hydraulics Section.
E. Razvan.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B4, p 26-35, 1967. 10 p, 8 fig, 8 ref.

Descriptors: *Turbulent flow, *Vortices, *Mathematical studies, Hydraulic jump, Stilling basins, Erosion, Scour, Alluvial channels, Open channel flow, Hydraulic models, Model studies.
Identifiers: *Macroturbulence.

Extinction of macropulsations and a constructive solution for the diminishment of the necessary length of bed protection downstream of dams are discussed. The theoretical extinction length is obviously higher than that resulting from empirical relations; level oscillations generated by hydraulic jump are significant. To reduce the macropulsation extinction length, the construction of a baffled apron downstream from the stilling basin is recommended. A reduction of 40 percent is possible, provided all other conditions should be the same. The proposed structure is in satisfactory use at various dams in Rumania. (Knapp-USGS)
W70-05947

MACROTURBULENCE OF A BOTTOM HYDRAULIC JUMP AND ITS INFLUENCE ON THE STABILITY OF THE BED OF THE LOWER TAILWATER,
Nauchno-Issledovatelskii Gidroenergeticheskii Institut, Tiflis (USSR).
T. G. Voinitch-Sianozhentskij, V. G. Lomtatidze, and G. N. Gvazava.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2. (Macroturbulence and stochastic processes in hydraulics), Paper B15, p 128-134, 1967. 7 p, 4 fig, 3 ref.

Descriptors: *Turbulent flow, *Vortices, *Drops (Structures), *Hydraulic jump, Open channel flow, Eddies, Alluvial channels, Scour, Stream erosion, Mathematical studies.
Identifiers: Macroturbulence.

Hydraulic jump is correlated with the amplitude of macropulsation of the hydraulic pressure and the kinetic energy of the pulsation movement. Stability of the lower tail-water attachment is studied using a dynamic theory of stability. Suggestions are given for calculating the necessary amount of bed protection downstream of hydraulic jumps. (Knapp-USGS)
W70-05949

DYNAMIC CHARACTERISTICS OF THE FORCES ACTING ON THE SPILLWAY CHUTE,
Central Research Inst. of Electric Power Industry, Tokyo (Japan). Technical Lab.
Chuichi Aki.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B19, p 163-170, 1967. 8 p, 5 fig, 3 tab, 7 ref.

Descriptors: *Turbulent flow, *Spillways, *Hydraulics, Turbulence, Closed conduits, Vortices, Hydrodynamics, Mathematical studies, Model studies, Hydraulic models.
Identifiers: *Aerodynamics (Hydraulic applications).

In connection with the construction of the pumped-storage power station of large capacity with the power house under the spillway chute, the dynamic characteristics of the forces acting on the chute during flood discharge were studied. The mean values of dynamic forces acting on the chute and the characteristics of their fluctuations depend on the characteristics of the turbulent boundary layer developing along the spillway chute. In order to analyze these forces, measurements were made of velocity distributions and pressure fluctuations on spillway chutes in the field and the laboratory. A relation developed in aerodynamics, applicable to the intensity, the spatial scale, and the frequency characteristics of pressure fluctuations in turbulent boundary layers was also applicable to the high velocity flow of water on spillway chutes. (Knapp-USGS)
W70-05953

THE EFFECT OF BEND ON THE DISTRIBUTION AND DEVELOPMENT OF THE MACROTURBULENCE INTENSITY IN OPEN CHANNEL BEDS,
Ceskoslovenska Akademie Ved, Bratislava. Inst. of Hydrology and Hydraulics.
E. Masiar.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2, (Macroturbulence and stochastic processes in hydraulics), Paper B18, p 154-162, 1967. 9 p, 3 fig, 5 ref.

Descriptors: *Turbulence, *Turbulent flow, *Meanders, *Alluvial channels, Open channel flow, Vortices, Model studies, Mathematical studies, Reynolds number.
Identifiers: *Macroturbulence.

In view of the fact that intensive channel-bed forming processes develop mostly in or near bends of open channels, the local turbulence intensity was studied to obtain a basis for determination of the relations between these two phenomena. The mean cross-section value of the macroturbulence intensity at the beginning of the bend first increases and having reached a maximum, decreases. This decrease sometimes reaches smaller values than in a direct section in front of the bend. All parameters influencing the value and distribution of mean longitudinal velocities also have an effect on the value and distribution of turbulence intensity in single cross-sections of the channel. (Knapp-USGS)
W70-05954

WAVE FORCES ON PILES: A DIFFRACTION THEORY,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
For primary bibliographic entry see Field 02L.
W70-05967

COMPUTATIONAL STUDY OF ACCELERATED FLOW IN A TWO-DIMENSIONAL CONDUIT EXPANSION,
Iowa Univ., Iowa City. Inst. of Hydraulic Research; and Carnegie-Mellon Univ., Pittsburgh, Pa. Biotechnology Program.
Enzo O. Macagno, and Tin-Kan Hung.
Journal of Hydraulic Research, Vol 8, No 1, p 41-64, 1970. 24 p, 6 fig, 13 ref.

Descriptors: *Open channel flow, *Turbulent flow, *Vortices, *Flow around objects, Hydraulics, Turbulence, Model studies, Hydraulic models, Fluid mechanics, Flow separation, Hydrodynamics, Viscosity.
Identifiers: Flow expansion, Accelerated flow, Vorticity.

The accelerated flow of a viscous fluid due to a suddenly established discharge in a two-dimensional conduit expansion has been determined by numerical integration of the governing differential equations. The complete form of the equation for diffusion and convection of vorticity was employed. The Reynolds number of the flow, based on the prescribed discharge, was 200. The growth of the separation zones, assuming symmetric flow, was

determined. Flow and vorticity patterns were calculated at short intervals of time; a selection of those patterns is presented, as well as curves showing the variation with time of the principal kinematic characteristics of the unsteady flow through the expansion. (Knapp-USGS)
W70-06105

SHIFTS OF SEDIMENT CONCENTRATION IN A VERTICAL PIPE,
Aberdeen Univ. (Scotland). Dept. of Engineering.
For primary bibliographic entry see Field 02J.
W70-06106

RESISTANCE STUDIES ON SMOOTH OPEN CHANNELS,
Indian Inst. of Tech., Kharagpur. Dept. of Civil Engineering.
V. V. Jayaraman.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY5, Paper 7266, p 1129-1142, May 1970. 14p, 10 fig, 2 tab, 9 ref, append.

Descriptors: *Open channel flow, *Hydraulic models, *Chezy equation, *Darcy-Weisbach equation, Correlation analysis, Steady flow, Uniform flow, Hydraulic similitude, Closed conduit flow, Hydraulics, Hydraulic radius, Fluid friction.
Identifiers: Hydraulic resistance.

Experiments were conducted on smooth open channels of different shapes to study the propriety of treating a channel as an equivalent pipe, the use of hydraulic mean radius and the application of pipe resistance laws to channels. The findings indicate that smooth pipe laws cannot be applied to smooth channels without reservations. A new approach has been suggested. The method takes into account the force causing motion, the geometrical parameters of the channel, and fluid properties. It is shown that it is possible to obtain mean velocity values without any need to determine the Darcy-Weisbach friction factor (f), or the mean shear stress along the boundary. (Knapp-USGS)
W70-06109

WORK-ENERGY EQUATION FOR THE STREAMLINE,
Iowa Univ., Iowa City. Coll. of Engineering.
For primary bibliographic entry see Field 02E.
W70-06112

STATISTICAL CHARACTERISTICS OF PRESSURE FLUCTUATIONS IN THE REGION OF HYDRAULIC JUMP,
Akademiya Nauk SSSR.
O. F. Vasiliev, and V. I. Bukreyev.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B1, p 1-8, 1967. 8 p, 8 fig, 6 ref.

Descriptors: *Hydraulic jump, *Pressure, *Statistical methods, Turbulence, Open channel flow, Critical flow, Time series analysis, Correlation analysis, Turbulent flow.
Identifiers: Kinematic flow analysis.

The statistical characteristics that have been experimentally obtained of the low frequency part of the pressure fluctuations spectrum on the rigid bottom of a turbulent flow in the region of a hydraulic jump include space-time double correlations, autocorrelations, spectra, one-dimensional frequency distribution, RMS values, skewness and flatness coefficients. The methods used in the investigation are described and an analysis is made of the kinematical structure of the flow. An example is given of numerical calculations of the average load on the apron. (Knapp-USGS)
W70-06167

MACROTURBULENCE PRODUCED BY VORTEX BREAKDOWN IN HIGH VELOCITY FLOWS,
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Ingenieria.
Enzo Levi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B7, p 54-60, 1967. 7 p, 7 fig, 4 ref.

Descriptors: *Turbulence, *Vortices, *Aeration, *Open channel flow, *Spillways, Hydraulic jump, Chutes, Drops (Structures), Overflow, Stilling basins, Weirs, Model studies, Hydraulic models.
Identifiers: *Macroturbulence, Longitudinal vortices.

Currents down steep chutes or spillways are normally streaked by longitudinal vortices embedded in them. Under favorable conditions, those vortices may break down and eventually mix up great quantities of atmospheric air. Some observations of the breakdown are described. It is explained how many macroturbulent effects usually ascribed to the boundary layer development may be imputed to breakdown. Finally an experiment which suggests an explanation of the inception of longitudinal vortices is described. (Knapp-USGS)
W70-06168

MACROTURBULENCE OF FLOWS BELOW SPILLWAYS OF MEDIUM HEAD DAMS AND THEIR PROTECTION AGAINST UNDERMINING,
Vsesoyuznyi Nauchno Issledovatelskii Institut Gidrotekhniki, Leningrad (USSR).
F. G. Gunko.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B16, p 135-143, 1967. 9 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Spillways, *Turbulence, *Scour, Vortices, Turbulent flow, Stilling basins, Drops (Structures), Hydraulics, Erosion, Energy dissipation.
Identifiers: *Macroturbulence.

Basic results of extensive studies by scientists on investigating operating conditions and energy dissipators below medium head spillways with large specific discharges are summarized. The experiments resulted in establishing the mechanism of flow action upon erodible coarse material by vortices in the area of intensive dissipation of excessive energy of the overflowing jet. These vortices cause an increase in velocity and pressure pulsation in the area under study. Investigations also showed that the intensity of action of highly turbulent flow on the erodible river bed can be characterized by sizes of gravel or stone lying on the bottom in the limit equilibrium state. Relationships were determined to relate water depths on the spillway apron, necessary stone sizes and the length of the rockfill pavement below the concrete slab of the spillway apron. (Knapp-USGS)
W70-06169

THE EFFECT OF MACROTURBULENCE IN THE TAILWATER OF TUBULAR SPILLWAYS ON TAILWATER STRUCTURES AND LOCAL SCOURING,
Kuybishev Civil Engineering Inst., Moscow (USSR).
N. P. Rozanov, L. S. Givotovsky, and N. N. Pashkov.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B17, p 144-153, 1967. 10 p, 6 fig, 10 ref.

Descriptors: *Scour, *Spillways, *Turbulence, Vortices, Turbulent flow, Stilling basins, Drops (Structures), Hydraulics, Erosion, Energy dissipation, Model studies, Hydraulic models.
Identifiers: *Macroturbulence.

Results are given of laboratory investigations of the effect of macroturbulence in the tailwater of tubular-type spillways on the tailwater structure and local scourings. Several layouts of tubular spillways were considered (single- and two-pipe with baffles and baffle piers) with stream impingement, ensuring sufficiently uniform distribution of specific discharge in the outlet channel. Values are tabulated of the pulsation coefficient for the hydrodynamic loads acting on the baffle piers and baffles under different conditions, the dependences to be used for determining the necessary thickness of fastening plates for a two pipe regulator, and charts of actual tailwater bottom velocities which are required for predicting scour. Scour is shown to be mainly determined by the bottom actual velocities. An approximated method for forecasting the depth of scoured holes is proposed. (Knapp-USGS)
W70-06170

PROBLEMS OF STABILITY OF STREAMS IN ERODED BEDS AND STABILITY OF THEIR SHAPES,
Nauchno-Issledovatelskii Gidroenergeticheskii Institut, Tiflis (USSR).
For primary bibliographic entry see Field 02J.
W70-06171

THE MEASUREMENT OF TURBULENT VELOCITY FLUCTUATIONS CLOSE TO A BOUNDARY IN OPEN CHANNEL FLOW,
University Coll., London (England). Dept. of Civil Engineering.
Patrick Hubert Kemp, and Anthony James Grass.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B24, p 201-209, 1967. 9 p, 5 fig, 7 ref.

Descriptors: *Sediment transport, *Turbulent flow, Open channel flow, Model studies, Hydraulic models, Tracking techniques, Turbulent boundary layers, Boundary layers.
Identifiers: Hydrogen bubble tracers.

Research in the field of hydraulic sediment transport has suffered limitation in the past primarily due to lack of adequate instrumentation for measuring the characteristics of the flow in the immediate vicinity of the grains. The paper describes a refined method of measuring the turbulent velocity field in the boundary layer of open channel flow, using the hydrogen bubble method. Results are presented which show that a higher degree of precision is achieved than comparable measurements made by previous investigators in air. Both smooth and rough boundaries have been studied. For comparison with previously published data, the presentation is restricted to the smooth boundary case. (Knapp-USGS)
W70-06172

ANALYSIS OF RANDOM PRESSURE FLUCTUATIONS IN STILLING BASINS,
Bureau of Reclamation, Denver, Colo. Div. of Research.
D. L. King.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B25, p 210-217, 1967. 8 p, 5 fig.

Descriptors: *Turbulence, *Stilling basins, *Model studies, Hydraulic models, Vortices, Instrumentation, Statistical methods, Hydraulic jump, Drops (Structures), Hydraulics.
Identifiers: *Pressure fluctuation measurement, Macroturbulence.

Knowledge of the amplitude-frequency spectrum of pressure fluctuations caused by turbulence in hydraulic structures allows the determination of dynamic loading in structural design. Recent experience with prototype structures has indicated fatigue failure caused by vibration. Pilot studies were made for electronic analysis of random pressure fluctuations in models of two distinct types of energy dissipators. The studies were restricted to determination of dynamic loads acting on the structures, without regard to the dynamic response of the structures. The results are discussed with respect to their application to design problems and possible sources of error are described. (Knapp-USGS)
W70-06173

OPTICAL METHOD FOR EXPERIMENTAL STUDIES ON TURBULENT FLOWS,
Vsesoyuznyi Nauchno Issledovatelskii Institut Gidrotekhniki, Leningrad (USSR).
For primary bibliographic entry see Field 07B.
W70-06174

STOCHASTIC ANALYSIS OF THE AUTO-FORMATION OF A CHANNEL CUT IN INCOHERENT ALLUVIUM,
Institute for Water Resources, Belgrade (Yugoslavia). Dept. of River Research.
For primary bibliographic entry see Field 02J.
W70-06175

SCATTERING OF SURFACE WAVES BY RECTANGULAR OBSTACLES IN WATERS OF FINITE DEPTH,
Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.
Chiang C. Mei, and Jared L. Black.
Available from the Clearinghouse as AD-700 897, $3.00 in paper copy, $0.65 in microfiche. Journal of Fluid Mechanics, Vol 38, Part 3, p 499-511, 1969, 21 refs, 7 figs. Contract Nonr-1841 (59).

Descriptors: Waves (Water), *Ocean waves, *Barriers, *Docks, *Piers, Bulkheads, Numerical analysis.
Identifiers: Surface properties, Rectangular bodies.

The scattering of infinitesimal surface waves normally incident on a rectangular obstacle in a channel of finite depth is considered. A variational formulation is used as the basis of numerical computations. Scattering properties for bottom and surface obstacles of various proportions, including thin barriers and surface docks, are presented. Comparison with experimental and theoretical results by other investigators is also made.
W70-06184

8C. Hydraulic Machinery

AUTOMATED VARIABLE FLOW FOR PILOT PLANTS,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 05D.
W70-06051

THE UNDERGROUND POWERPLANT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 08E.
W70-06242

CAVITATION MEASUREMENT ON WATER TURBINES,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
Haruyuki Suzuki, and Akihiko Aihara.
Water Power, Vol 22, No. 1, p. 10-15, Jan 1970. 6 p, 16 fig, 1 tab.

Descriptors: *Cavitation, *Hydraulic turbines, Measurement, Sound waves, Measuring instruments, Laboratory tests, Field tests, Vibrations, Foreign research, Oscillographs, Experimental data, Turbine runners, Oscillation, Francis turbines, Ultrasonics, Acoustic equipment.
Identifiers: Japan, *Cavitation noise, Cavitation parameters, Test results, Turbine efficiency, Air admission, Ultrasonic cavitation tests.

A method of detecting cavitation in water turbines under operating conditions is described. Relative intensity of cavitation can be determined by measuring the intensity of ultrasonic waves generated by cavitation. By adopting this measuring method, various aspects of cavitation under different conditions were visually observed during laboratory tests, while at the same time the intensities of the ultrasonic waves from cavitation were measured. After establishing this relationship, measurements of cavitation in many water turbines were performed. Results of measurements on full-scale turbines are given. (USBR)
W70-06244

THERMODYNAMIC EFFICIENCY TESTS ON MURRAY 1 TURBINES,
Glasgow Univ. (Scotland).
A. S. Thom, and T. R. Foord.
Water Power, Vol. 21, No. 12, p. 474-478, Dec. 1969. 5 p, 1 fig, 6 photo, 2 tab, 3 ref.

Descriptors: *Hydraulic turbines, *Efficiencies, Test procedures, Guide vanes, Acceptance testing, Maintenance, Theory, Calorimeters, Temperature, Temperature sensors, Bridges (Electric), Draft tubes, *Turbines, *Francis turbines.
Identifiers: *Turbine efficiency, Murray 1 Proj (Australia), Australia, *Thermodynamic method, Temperature rise, Test results, Foreign testing.

Efficiency tests to determine the effect of guide vane alteration were performed by the thermodynamic method on three 100-mw Francis turbines at the Murray 1 Project, Australia, before acceptance of the machines. The theory involved in making these tests, apparatus used, test procedures, and results are described. The tests demonstrate the ease and simplicity of application of the thermodynamic method as an absolute and as a comparative method, and its suitability for contractual and maintenance tests on hydraulic turbines at hydroelectric plants. (USBR)
W70-06245

THE PEACE RIVER PROJECT--FROM FEASIBILITY REPORT TO FIRST POWER OUTPUT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
W. F. Miles.
Engineering Journal, Canada, Vol 52, No 10, p 12-24, Oct 1969. 13 p, 10 fig.

Descriptors: Feasibility studies, History, *Foreign projects, *Foreign construction, Foreign design practices, Hydroelectric plants, Spillways, Projects, Earth dams, Transmission lines, *Hydroelectric power.
Identifiers: W A C Bennett Dam (Canada), Portage Mountain Dam (Canada), Portage Mountain Pwrplt (Canada), Canada, *Peace River Proj (Canada).

A history is given of the Peace River Project, including a general description of principal components--the Portage Mountain Development, Site 1 Development, and the 500-kv transmission lines to the lower mainland of British Columbia. The height of W A C Bennett Dam (600 ft), the capacity of the reservoir (57 million acre-ft), and the capacity of the underground power facilities (2270 megawatts) combine to place the Peace River Project among the larger hydroelectric projects in the world. Changes made from the original feasibility concept of the project prepared in 1959, and some organizational and administrative aspects of construction of Portage Mountain Development are discussed. (USBR)
W70-06251

TRANSISTORIZED GROUND-FAULT INTERRUPTER REDUCES SHOCK HAZARD,
California Univ., Berkeley.
Charles F. Dalziel.
Inst Elec Electron Eng Spectrum, Vol 7, No 1, p 55-62, Jan 1970. 8 p, 12 fig, 6 ref.

Descriptors: *Safety, *Electric currents, *Interrupters, Fires, Faults (Electrical), Transistors, Electric relays, Electric wires, Hazards.
Identifiers: *Electric shock, Industrial equipment, *Protection (Electrical), Magnetic amplifiers, Ground currents.

A ground-fault interrupter (GFI) is a device that interrupts an electric circuit when the fault current exceeds a predetermined value less than that required to operate the overcurrent devices of the circuit. Recently, developments have been made of 2- and 3-wire transistorized GFI's having a continuous rating of 100 or 200 amp and a ground-current trip value of 5 milliamperes. The operating time of these devices is so fast, and the corresponding shock energy so small, that the modern GFI's virtually eliminate electrocutions, burndowns, and fires caused by currents flowing to ground. The sensitive ground-fault mechanism does not respond to line-to-line or 3-phase faults unless zero phase-sequence currents are involved. Several types of interrupters are described, and results of human and animal shock testing are discussed. (USBR)
W70-06255

AIR POLLUTION AND ATOMIC POWER,
For primary bibliographic entry see Field 05G.
W70-06259

STABILITY AND VOLTAGE REGULATION OF LARGE TURBO-ALTERNATORS IN POWER SYSTEMS: EFFECT OF MACHINE DATA AND EXCITATION SYSTEMS,
Brown, Boveri und Cie, A. G., Mannheim (West Germany); and Brown, Boveri and Co. Ltd., Baden (Switzerland).
D. Oeding, and P. Nemetz.
Conf Pap No 70 CP 199 - PWR, Inst Elec Electron Eng Winter Power Meet, New York, NY, Jan 1970. 10 p, 16 fig, 4 tab, 14 ref.

Descriptors: *Electric generators, *Electrical stability, *Excitation, Voltage regulators, Reactance, Digital computers, Transients, Computer programs, Diodes (Electron tubes), Faults (Electrical), Characteristics, Voltage regulations, Foreign research, Capacitance, Inductance, Simulation, Mathematical models.
Identifiers: *Thyristors, Short circuits, Switzerland, Transient stability, Germany.

Steady-state and transient stability and the voltage regulation of large turboalternators, connected to power systems with different reactances and time constants and different excitation systems, are investigated using digital computer programs. Digital programs used for simulation of a synchronous machine, the excitation equipment, and the system connection are described. The effect of excitation systems on the operating characteristics of machines with either a rotating a-c exciter and diodes or with thyristors fed from the generator terminals is shown when the value of the transient reactance increases. The improvement of machine operating characteristics by supplementary signals depending on rotor slip and acceleration is discussed when thyristor excitation from the generator terminals is used to excite large standard generators. (USBR)
W70-06261

AGING IN ROTATING MACHINERY INSULATING MATERIALS,
Westinghouse Electric Corp., East Pittsburgh, Pa.; General Electric Co., West Lynn, Mass; and Naval Ship Research and Development Center, Annapolis, Md.
J. C. Botts, E. A. Boulter, and R. J. Flaherty.

Conf Pap No 70 CP 59 - PWR, Inst Elec Electron Eng Winter Power Meet, New York, NY, Jan 1970. 6 p.

Descriptors: *Aging (Physical), Temperature, *Evaluation, Standards, Test procedures, Physical properties, Thermal properties, Electrical coronas, Materials testing, *Electric generators, *Electric motors, *Electric insulation.
Identifiers: *Rotating machines, *Test codes, Operating temperature, Synchronous machines, Service life.

The modern history of progress in evaluating rotating machinery insulation materials and systems is summarized. Changes in properties of insulation under service conditions and the development of accelerated functional tests for establishing materials indices and insulation systems classification are reviewed. The Rotating Machinery Insulation Subcommittee and its working groups have developed several new test guides and standards, extending older concepts of insulation evaluation to new classes of rotating machines and introducing new concepts of functional aging tests. A listing and current status of the Institute of Electrical and Electronic Engineers and International Electrotechnical Commission test guides and standards for rotating machines are included. (USBR)
W70-06262

8D. Soil Mechanics

THE STRENGTH AND CREEP OF FROZEN SOILS AND CALCULATIONS FOR ICE-SOIL RETAINING STRUCTURES,
Cold Regions Research and Engineering Lab., Hanover, N.H.
S. S. Vyalov, V. G. Gmoshinskii, S. E. Gorodetskii, V. G. Grigorieva, and Yu K. Zaretskii.
Available from the Clearinghouse as AD-484 093, $3.00 in paper copy, $0.65 in microfiche. Izatel'stvo Akademii Trans of Nauk SSR, Moscow, 1962. CRREL-Trans-76, September 1965. 324 p, 82 ref.

Descriptors: *Frozen soils, *Permafrost, Soil engineering, Soil mechanics, Construction materials, Soil structure, Foundations, Mining engineering, Walls, Rheology, Deformation, Stress, Mechanical properties, Creep, Test procedures, Failure (Mechanics), Moisture, Ice, Particle size, Tundra, Frost, Soil texture.
Identifiers: Soil engineering.

Since frozen soils are relatively strong and watertight, they may be used successfully as materials for various types of engineering construction. For example, artificially frozen soils may be used as retaining structures during mining and under complex hydrogeological conditions for sinking openshafts. When plans and static calculations are being made for constructions on frozen soils, it is necessary to take into consideration the specific properties of such soils. The strength and deformation properties of frozen soils depend essentially upon soil-temperature, soil-composition, and soil-texture (grain-size distribution, moisture content, ice content, frost texture, etc.). Furthermore, the stress-deformation characteristics of frozen soils depend to a very large degree upon the time factor. Since ice and unfrozen water are present, the soils possess clearly defined rheological properties, such as increasing deformation with time (creep), and relaxation and reduction of strength. This book is devoted to the study of the rheological properties of frozen soils and to the development of methods for calculating creep and long-term strength of retaining structures made from artificially frozen soils.
W70-05968

LAND SUBSIDENCE DUE TO THE APPLICATION OF WATER,
Geological Survey, Sacramento, Calif.
Ben E. Lofgren.
Reviews in Engineering Geology II, Geological Society of America, p 271-303, 1969. 33 p, 10 fig, 3 plate, 2 tab, 42 ref.

Descriptors: *Land subsidence, *Compaction, *Infiltration, Permeability, Pore pressure, Soil physical properties, Engineering geology, Foundations, Particle size, Particle shape, Clays, Clay minerals, Soils.
Identifiers: Hydrocompaction.

Loose, dry, low-density deposits that compact when they are wetted mantle extensive areas in North America, Europe, and Asia. This process, here referred to as hydrocompaction, has produced widespread subsidence of the land surface. Hydrocompaction may occur under natural overburden load or may occur only with the addition of a surcharge load. Deposits that subside because of hydrocompaction are generally one of two types: (1) loose, moisture-deficient alluvial deposits; and (2) moisture-deficient loess and related eolian deposits. Such deposits occur in regions where seasonal rainfall seldom, if ever, is sufficient to penetrate below the root zone; thus, they have remained moisture deficient throughout their post-depositional history and are readily susceptible to hydrocompaction when they are artificially wetted. Subsidence due to hydrocompaction is of serious concern in the design and maintenance of aqueducts, buildings, pipe lines, highways, and other major engineering structures. Damage usually can be minimized by precompacting the deposits before construction begins. (Knapp-USGS)
W70-06150

W A C BENNETT DAM,
International Power and Engineering Consultants Ltd, Vancouver (British Columbia).
H. Taylor.
Engineering Journal Canada, Vol 52, No 10, p 25-34, Oct 1969. 10 p, 12 fig, 1 tab, 6 ref.

Descriptors: *Earth dams, Zoned embankments, *Dam design, Performance, Dam foundations, Stability analysis, Seismic design, Seepage, Settlement (Structural), Foreign construction, *Dam construction, Drainage systems, Earth materials, Instrumentation, Geology, Grout curtains, Hydrostatic pressure, Soil investigations, Transition zones, Soil compaction.
Identifiers: *W A C Bennett Dam (Canada), Design modifications, Drain holes, Seismic stability, Blanket grouting, Dam stability.

W A C Bennett Dam (formerly Portage Mountain Dam) is a 600-ft-high, zoned earthfill dam, constructed across the Peace River Canyon in Canada. Site geology, foundation treatment, embankment design procedures, materials exploration, changes made during construction, instrumentation, and performance of the dam are discussed. The dam has a wide central core of silty sand. Downstream from the core are transition, filter, and drainage zones. The upstream and downstream shells are random gravelly fill. Materials for the dam were obtained from 2 large moraines located about 4 mi from the damsite. Materials were processed for the core, transition, filter, and drainage zones. Random fill was pit run. The dam foundation consists of thick beds of sandstone separated by relatively thin beds of shale and coal. Preparation of the bedrock surface was confined to the core contact area and consisted of removing weathered and fractured rock, shaping the canyon walls, and blanket grouting. The foundation was curtain grouted up to 350 ft deep for the full length of the dam. Drainage tunnels and drain holes were provided in the abutments to reduce hydrostatic pressures downstream from the grout curtain. (USBR)
W70-06250

RECLAMATION AND REUSE - THE STATE OF THE ART,
Los Angeles County Sanitation District, Calif.
John D. Parkhurst.
Report No 16, Proc Water Qual Manage Symp, Univ Calif, Davis, June 1969. 12 p, 2 tab.

Descriptors: *Reclaimed water, *Water reuse, Reviews, Water treatment, Demineralization, *Waste water treatment, Electrodialysis, California, Sewage treatment, Treatment facilities, Sanitary engineering, Separation techniques, Spreading basins, Water quality, Filtration, Ion exchange, Tertiary treatment, Nutrients, Nitrates, Phosphates, Reverse osmosis.
Identifiers: Renovating.

The sewerage system of the Los Angeles County Sanitation Districts serves about 4 million people in 71 incorporated cities and large tracts of unincorporated areas. Because of the serious problems caused by water shortage in these heavily populated areas, the sanitation districts have instituted the latest techniques and facilities in water reclamation. The Whittier Narrows Plant, the Pomona research and demonstration program, and the Lancaster project provide sound data for future planning of similar facilities. The initial stages of the 40-yr master plan that will provide approximately 440 mgd of potentially reusable water in the districts' system are underway. The sanitation districts in Los Angeles County are pursuing research and pilot scale operations of various tertiary treatment processes to provide reclaimed water of any desired quality. Descriptions are given of the processes being used. (USBR)
W70-06260

8E. Rock Mechanics and Geology

THE UNDERGROUND POWERPLANT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
H. Lauga.
Engineering Journal, Canada, Vol 52, No. 10, p. 35-42, Oct. 1969. 8 p, 7 fig.

Descriptors: *Underground powerplants, Underground structures, Design, Tunnels, *Penstocks, Intake structures, Geologic investigations, Foreign construction, Grouting, Powerhouses, *Hydroelectric plants, Tailrace, Rock bolts, Fabrication, Mechanical equipment, Electrical equipment, Structural design.
Identifiers: Bellmouths, *Peace River Proj (Canada), Manifolds, Canada, Earthquake loads, Electroslag welding, Portage Mountain Pwrplt (Canada).

In the Portage Mountain Development in Canada, the water passages and power generating units are located underground. The powerhouse was designed to house 10 vertical-shaft Francis turbines and directly connected generators, each rated at 227,000 kw. The main structural aspects of the power intakes and the principal components of the underground complex including the penstocks, powerhouse, and manifolds are described. Road and railroad limitations required penstock sections to be fabricated at the site. Electroslag welding was used to fabricate 24-ft-long penstock sections from the 8-ft-long half-can plates supplied by the fabricator's shop. Penstock plate thickness varies from 2 in. at the powerhouse to 1-1/2 in. for the upstream end. The geological investigations required for the powerhouse are discussed. Approximately 1,000,000 cu yd of rock were removed to complete the underground excavation for the powerplant, and approximately 400,000 cu yd of concrete will be placed before completion. (USBR)
W70-06242

8F. Concrete

CONCRETE PERFORMANCE IN GLEN CANYON DAM, ARIZONA - 5-YEAR CORE REPORT,
Bureau of Reclamation, Denver, Colo.
J. R. Graham.

Bur. Reclam Report C-1067A, Oct. 1969. 22 p, 10 fig, 9 tab, 3 ref.

Descriptors: *Concretes, *Compressive strength, Poisson ratio, *Mass concrete, Concrete control, Elasticity modulus, *Concrete dams, Concrete testing, *Cores, Laboratory tests, Pozzolans, Concrete mixes, Aging (Physical), Concrete technology.
Identifiers: *Concrete properties, Glen Canyon Dam, Colorado River Storage Proj, Longtime tests.

Results of physical properties tests conducted on cores drilled from mass concrete in Glen Canyon Dam, Ariz, at 6 mo and 1, 2, and 5 yr age indicate a good-quality, uniform, well-consolidated concrete exceeding established design criteria. The study is part of a series in the Bureau of Reclamation's 20-yr evaluation of strength and elastic properties of concrete in various dams. Average 5-yr compressive strength was 5220 psi for interior concrete and 5640 psi for exterior concrete. Average 5-yr moduli of elasticity of the interior and exterior concretes were 6.07 and 6.29 million psi, respectively. Cement efficiencies, coefficient of variation of strengths, and Poisson's ratios are discussed. (USBR)
W70-06247

SOME FIELD EXPERIENCE IN THE USE OF AN ACCELERATED METHOD OF ESTIMATING 28-DAY STRENGTH OF CONCRETE,
Department of Energy, Mines and Resources, Ottawa (Ontario).
V. M. Malhotra, and N. G. Zoldners.
Digest Suppl, Amer Concr Inst J Proc, Vol 66, No 11, p 894-906, Nov 1969. 20 p, 15 fig, 6 tab, 11 ref, append.

Descriptors: *Concrete testing, Estimating, Test specimens, Strength, *Test procedures, Compressive strength, Field tests, Testing, Concrete technology, Laboratory tests, Concrete mixes.
Identifiers: *Accelerated testing, *Boiling method (Concrete), Foreign testing, Canada, Test results, Concrete properties.

Since 1963, the Department of Energy, Mines and Resources, Ottawa, Canada, has been engaged in developing an accelerated test for estimating the 28-day compressive strength of concrete. Results of the research work were presented at the 17th ACI Fall Meeting at Miami, Fla, in Nov 1964. The method, known as the modified boiling method, consists of standard moist-curing of test specimens for 24 hr, followed by boiling in water for 3-1/2 hr, and testing for compression 1 hr later. The method was selected by the ASTM as one of the 3 most promising methods for an international cooperative testing program. Since the introduction of the method, several ready-mixed concrete producers in Newfoundland, Quebec, and Ontario, testing companies in Quebec and British Columbia, and provincial and municipal authorities in Quebec have installed suitable equipment. The method has been used, with and without modification, as a routine control test. One Federal agency has subjected the method to further laboratory testing. Data obtained by organizations using the accelerated testing method are reviewed. (USBR)
W70-06252

TORSIONAL STRENGTH AND BEHAVIOR OF SPANDREL BEAMS,
Rice Univ., Houston, Tex.; and Arkansas Univ., Fayetteville.
James O. Jirsa, John L. Baumgartner, and Nathan C. Mogbo.
J Amer Concr Inst Proc, Vol 66, No 11, p 926-932, Nov 1969. 7 p, 6 fig, 4 tab, 12 ref.

Descriptors: *Beams (Structural), *Torsion, Cracking, Moments, Strain, Reinforced concrete, Shear stress, *Structural behavior, Rotation, Test procedures, Structural members, Structural models, Deflection, Twisting, Structural engineering, Stress, *Model tests, Twisting stress, Slabs, Columns.
Identifiers: *Spandrel beams, Concrete slabs, Ultimate strength.

Nine specimens simulating the edge of a floor slab structure adjacent to an exterior column were tested to determine the torsional strength and behavior of typical spandrel beam configurations. The influence of the slab on the torsional strength and on the mode of failure of the spandrel beam was examined. Effects of shear-torsion and moment-torsion interaction on the torsional strength of the spandrel beam were estimated. Applicability of equations developed previously by other investigators for the torsional strength of isolated beams was examined. The behavior of the spandrel beams indicates that the slab does not participate directly in resisting the applied torsional forces; the beam may be considered as a rectangular cross section in computing torsional strength. Under the loading conditions used, the slab appeared to contribute indirectly to the torsional strength of the beam by restraining the beam against longitudinal extension under torsional deformation and thereby exerting an axial force on the beam. The torsional strength using equations developed by Collins and Hsu was conservative for the specimens tested. (USBR)
W70-06253

THE USE OF MODEL TESTS IN THE DETERMINATION OF THE SAFETY FACTOR IN ARCH DAMS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 08A.
W70-06254

THE PRODUCTION AND PROPERTIES OF HIGH-STRENGTH CONCRETE,
Cement and Concrete Association, London (England).
L. J. Parrott.
Concrete, Vol 3, No 11, p 443-448, Nov 1969. 6 p, 6 fig, 2 tab, 4 ref.

Descriptors: Concretes, *Concrete technology, *Concrete mixes, Concrete structures, Concrete testing, Foreign research, Portland cements, Coarse aggregates, Crushed stones, Mechanical properties, Creep, Physical properties, Compressive strength, Tensile strength, Heat of hydration, Shrinkage, Elasticity (Mechanical), Costs, Workability.
Identifiers: *High strength concretes, Structural concrete, Great Britain.

Experimental work demonstrates the feasibility of making concrete with 28-day cube strengths of 11,600 psi, using a wide range of constituents. Strengths of 13,100 to 14,500 psi are attainable with a limited range of constituents without recourse to unusual materials or processing methods and without incurring significant technical penalties. Crushed rock such as hard limestone, granite, basalt, or dolerite is suitable coarse aggregate for high-strength concrete. Selective cement may be necessary to produce concrete of strengths above 13,100 psi. Mix design, workability, costs, compressive and tensile strengths, elasticity, shrinkage, creep, heat of hydration, thermal expansion, and density are discussed. The work described should provide sufficient information for estimating the usefulness of high-strength concrete in most structures. If a precise estimate is required, further studies should be made on: (1) effects on creep of stress level and age at loading, (2) movements at early ages in restrained and unrestrained structural elements, (3) short-term and long-term loading tests, and (4) site trials to determine placing and compacting costs. (USBR)
W70-06256

8G. Materials

HOW TO INSTALL FLEXIBLE MEMBRANE CANAL LININGS,
For primary bibliographic entry see Field 03F.
W70-06007

IN-SITU-FABRICATED MEMBRANES,
Witco Chemical Corp., New York. Pioneer Div.; and Witco Chemical Corp., New York. Research and Development Lab.
For primary bibliographic entry see Field 04A.
W70-06017

ECONOMIC COMPARISONS OF OPEN CONDUIT AND PIPE IRRIGATION DISTRIBUTIONS SYSTEMS,
Bureau of Reclamation. Div. of Irrigation Operations.
For primary bibliographic entry see Field 03F.
W70-06025

AGING IN ROTATING MACHINERY INSULATING MATERIALS,
Westinghouse Electric Corp., East Pittsburgh, Pa.; General Electric Co., West Lynn, Mass; and Naval Ship Research and Development Center, Annapolis, Md.
For primary bibliographic entry see Field 08C.
W70-06262

8I. Fisheries Engineering

THE CREATION OF SPAWNING FIELDS IN RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Narragansett, R.I. Narragansett Marine Game Fish Research Lab.
F. Nezhivenko.
Available from the Clearinghouse as PB-189 113T, $3.00 in paper copy, $0.65 in microfiche. Translation from Rybnde Khozyaistvd, Vol. 45, No. 2, Feb 1969. 2p.

Descriptors: *Spawning, *Fish farming.

In the middle and lower section of Kremenchugskoe Reservoir, as well as in many other reservoirs, essentially there is no substrate for the deposit of spawn by fish during spring spawning. At the Cherkasskii Fishermans Collective Named after Shevchenko, based on perennial observations on fish spawning, the conditions of spawn incubation on nests, and emergence of the fry of the fish, a method has been developed for the creation of whole spawning fields. Artificial shrubs form the basis of these fields. (Author)
W70-06030

REGULATIONS APPLYING TO SPECIFIC VARIETIES OF FISH.
For primary bibliographic entry see Field 06E.
W70-06191

DISTINCTIVE ASPECTS OF THE ECOLOGY OF STREAM FISHES: A REVIEW,
Fisheries Research Board of Canada, Nanaimo (British Columbia). Biological Station.
For primary bibliographic entry see Field 06G.
W70-06220

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WATER RESOURCES RESEARCH IN OKLAHOMA.
Oklahoma Water Resources Research Inst., Stillwater.
For primary bibliographic entry see Field 09D.
W70-06027

ANNUAL REPORT OF WATER RESOURCES RESEARCH ACTIVITIES UNDER PUBLIC LAW 88-379, FISCAL YEAR 1969.
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

Available from the Clearinghouse as PB-191 166, $3.00 in paper copy, $0.65 in microfiche. Virginia Polytechnic Institute Water Resources Research Center Report, 1969. 118 p, 7 fig, 12 tab. OWRR Project A-999-VA.

Descriptors: *Water resources, *Research and development, *Water resources research act, *Virginia, Colleges, Contracts, Grants, Water pollution control, Evapotranspiration, Evapotranspiration control, Small watersheds, Hydrologic cycle, Water balance, Mathematical models, Water quality, Estuaries, Streams, Water wells, Aquifers, Groundwater, Surface waters.
Identifiers: Virginia Polytechnic Institute.

A summary of the fifth Annual Report was submitted to the Office of Water Resources Research by the Water Resources Research Center, Virginia Polytechnic Institute. Research of F. Y. 1969 included: Removal of Trace organics from Water by adsorption on coal; microbial release of soluble phosphate in activated sludge; solar reflectance of monolayer-covered water surfaces; evaporation suppression; digital simulation of the hydrologic cycle on small agricultural watersheds; perception of water resource problems; stochastic models for pollution and dissolved oxygen in streams; adsorption of organic compounds onto solids; groundwater reservoir response to earth tides; invasion of the aquatic habitat by amphibious species of polygonum; treatment of dyeing bath wastes by foaming and flotation; effects of zooplankton on photosynethesis by algae in lakes; and biological and chemical studies of Virginia's estuaries. Training and education aspects of the water resources research program are listed, as well as publications and theses resulting from all WRRC studies. (Knapp-USGS)
W70-06028

SERVICE TO NEW YORK STATE: A SUMMARY REPORT 1965-69.

Cornell Univ Water Res and Marine Science Center, Service to New York State, Summary Rept, pub 28, Nov 1969, 52 p, 5 app.

Descriptors: *New York, *Water Resources Research Act, *Water resources planning, *Universities, Engineering, Agriculture, Economics, State governments, Public health, Regional analysis, Grants, Research facilities, Great Lakes, Administrative agencies, Water pollution control, Water demand, Human population, Industrial plants, Legal aspects, Colleges, Allotments, Systems analysis, Federal government, Research and development.
Identifiers: *Water research centers.

To provide for graduate education and research, Cornell University established a Water Resources Center in 1962. Topics of central concern to the Center were: (1) water supply and demand of New York and the Northeast; (2) water law and institutions; (3) studies of the Great Lakes and Finger Lakes of New York; (4) relevant aspects of pollution, land use, economics, government, and public health; and (5) application of systems-analysis techniques to improve water management. In 1965 the Center won federal support under the Water Resources Research Act. In 1968 the Center undertook studies in marine research and was renamed the Cornell University Water Resources and Marine Sciences Center. This Report describes the sources of research programs and their relevance to New York state. Listed are research reports, publications and recommendations resulting from the studies. (Hubener-Florida)
W70-06198

EDUCATING THE PUBLIC IN NATURAL RESOURCES,
Wisconsin Univ., Madison. Dept. of Journalism; and Wisconsin Univ., Madison. Dept. of Wildlife Ecology.
For primary bibliographic entry see Field 05G.
W70-06228

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES RESEARCH IN OKLAHOMA.
Oklahoma Water Resources Research Inst., Stillwater.

Available from the Clearinghouse as PB-191 216, $3.00 in paper copy, $0.65 in microfiche. Oklahoma Water Resources Research Institute Report, (1969). 48 p. OWRR Project A-999-OKLA.

Descriptors: *Allotments, *Grants, *Research and development, *Universities, Colleges, Facilities, Institutions, Laboratories, Professional personnel.

This brochure is an attempt to describe some of the centers of water research and some of the projects which are currently underway in Oklahoma or which have been recently completed. It is hoped that this brochure will not only be information to the general public, but that it will also aquaint many scientists with related communications, reports of other organizations and federal catalogs especially Volume 3 of the Water Resources Research Catalog.
W70-06027

ANNUAL REPORT OF WATER RESOURCES RESEARCH ACTIVITIES UNDER PUBLIC LAW 88-379, FISCAL YEAR 1969.
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
For primary bibliographic entry see Field 09A.
W70-06028

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W70-06198

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WATER RESOURCES REPORTS AND PAPERS IN THE J. B. LIPPINCOTT COLLECTION,
California Univ., Berkeley.
Gerald J. Giefer, and Anelle McCarty Kloski.
Water Resources Center Archives Series Report No 21, California University, Berkeley, January 1970. 301 p.

Descriptors: *Bibliographies, *Libraries, Universities, Documentation, Publications, Water resources development, Hydrology, Hydraulics, Surveys, Investigations, Geology.
Identifiers: *J. B. Lippincott collection.

This is an annotated listing of reports, papers and photographs in the J. B. Lippincott collection, Water Resources Center Archives, University of California, Berkeley. The collection is arranged in the order in which it was kept by Mr. Lippincott, i.e., alphabetically by name of contracting agency, project title, or geographical entity. Manuscript materials in the collection of the Water Resources Center Archives cannot be loaned. Arrangements can be made to photocopy items of interest. (Knapp-USGS)
W70-05914

THE EFFECTS OF ELEVATED TEMPERATURE UPON AQUATIC INVERTEBRATES--A REVIEW OF LITERATURE RELATING TO FRESH WATER AND MARINE INVERTEBRATES,
John Hopkins Univ., Baltimore, Md. Dept. of Geography.
For primary bibliographic entry see Field 05C.
W70-05962

BENTHIC MACROINVERTEBRATES AND PERIPHYTON.
Midwest Benthological Society.
For primary bibliographic entry see Field 05C.
W70-05989

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AUGUST 15, 1970

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
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VOLUME 3, NUMBER 16
AUGUST 15, 1970

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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nce Journal, Vol 5A, No 5, p 60-65, November 9. 6 p, 4 fig, 5 ref.

criptors: *Water structure, *Hydrogen bond- *Ions, Molecular structure, Polarity, Water erties, Water chemistry, Freezing, Melting,

tifiers: Water polymers.

ent research in the structure of water is briefly ewed. The topics discussed are normal water cture, ice structure, water polymers, ion-water tions, biological aspects of water structure, bility of hydrocarbons, hydration, high pres- water structures, and thermodynamics of er. (Knapp-USGS)
0-06537

. Aqueous Solutions and Suspensions

RTHER STUDIES OF PROPERTIES OF SEA TER AND ITS CONCENTRATES TO 200 G C,
ifornia Univ., Berkeley.
primary bibliographic entry see Field 03A.
0-06331

. WATER CYCLE

. General

FLUENCE OF TIDAL INLETS ON SALINITY D RELATED PHENOMENA IN ESTUARIES,
as Univ., Austin. Hydraulic Engineering Lab.
primary bibliographic entry see Field 02L.
0-06315

UVIAL PHYSIOGRAPHY AS A FACTOR IN SIN RESPONSE,
lorado State Univ., Fort Collins. Dept. of Civil gineering.
stafa Elmas Ulugur.
D dissertation, Colorado State University, Fort llins, June 1969. 155 p, 31 fig, 18 tab, 126 ref, 4 pend.

scriptors: *Rainfall-runoff relationships, *Ru- F forecasting, *Routing, *Rational formula, inage, Equations, Peak discharge, Runoff coef- ent, Watersheds (Basins), Mathematical stu- s, Flood routing, Hydraulics, Hydrography, pography.
ntifiers: Radiality coefficient, Drainage efficien-

e effect of the fluvial physiography on basin ponse was studied and two new fluvial parame- s were defined. The first of the new parameters he radiality of the tributaries within the basin. It measure of flood synchronization from various butaries. For a semicircular basin with an outlet the center, the radiality is 1.00. For differenct ues of radiality, routing shows that the flood drographs from tributaries shift when radiality is v. When radiality is high, they become a family hydrographs very close to each other. The cond of the new parameters is the drainage effi- ncy index that expresses whether the channel w or overland flow is dominant. The increase in e drainage efficiency index increases peak charge in two ways: (1) by decreasing the time concentration; (2) by increasing the total lume of runoff. A new formula for flood predic- tion from intermediate-sized basins is introduced to replace the older rational formula. The new formula contains all the parameters appearing in rational formula including the slope and newly defined fluvial parameters. (Knapp-USGS)
W70-06345

HYDROLOGY OF A SMALL RURAL WATERSHED UNDER SUBURBAN DEVELOPMENT - PHASE I,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Kurt Nathan, George H. Nieswand, and Anthony J. Esser.
Available from the Clearinghouse as PB-191 715, $3.00 in paper copy, $0.65 in microfiche. Completion Report, New Jersey Water Resources Research Institute, Rutgers University, March 1970. 86 p, 34 fig, 15 ref. OWRR Project A-009-NJ (3).

Descriptors: *Small watershed, *Rainfall-runoff relationships, Basins, Hydrographs, Runoff, Storm runoff, Surface runoff, Time lag, Time of concentration, Unit hydrographs.
Identifiers: Suburban hydrology, Hydrologic change.

A small rural watershed in New Jersey is being studied for changes in hydrological characteristics during suburban development. Two stream gaging stations and two recording precipitation gages have been established in the area. During Phase I, covered in this report, regression models for the hydrological properties have been derived for the undeveloped basin. A standard unit hydrograph has also been established for this period. Monitoring of water quality has been initiated recently. The study will be continued during Phase II and III, during and after development. (Nathan-Rutgers)
W70-06447

DYANMIC HYDROLOGY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
Peter S. Eagleson.
New York, McGraw-Hill, Inc, 1970. 462 p, 170 fig, 36 tab, 305 ref, 4 append.

Descriptors: *Hydrology, *Hydrologic cycle, *Rainfall-runoff relationships, *Streamflow, *Mathematical models, Water balance, Hydrologic budget, Fluid mechanics, Hydrodynamics, Groundwater movement, Infiltration, Soil water, Climatology, Synoptic analysis, Surface-groundwater relationships, Energy budget, Runoff, Overland flow, Snowmelt, Evaporation, Transpiration, Evapotranspiration, Lakes, Oceans, Atmosphere, Solar radiation, Thermodynamics.
Identifiers: *Dynamic hydrology, Textbook.

The principal physical processes of interest to engineering hydrologists are summarized in a textbook intended for use by professionals and advanced students who have at least some basic knowledge of fluid mechanics. Where possible, processes are analyzed using mathematical models which satisfy 1, physical validity, using the essential concepts of fluid dynamics and thermodynamics, confirmed by observation; and 2, simplicity, to encourage and facilitate the use of models. The topics discussed include: history of hydrology; the hydrologic cycle; transport processes in the atmosphere and oceans; composition of the atmosphere; composition of the oceans and lakes; energy balance of the Earth; planetary fluid dynamics; atmospheric circulation; general circulation of the oceans; climatic variability; precipitation; evaporation and transpiration; snowmelt; infiltration and groundwater flow; surface runoff and streamflow; and catchment morphology and rainfall-runoff relationships. Appendices give units of measure, constants, solar attitude, and solutions to the one-dimensional diffusion equation. (Knapp-USGS)
W70-06522

ESTIMATION OF MAXIMUM FLOODS.

World Meteorological Organization Technical Note No 98 (WMO-No 233.TP.126), Geneva, Switzerland, 1969. 288 p, 60 fig, 24 tab, 128 ref.

Descriptors: *Flood forecasting, *Frequency analysis, Routing, Hydrograph analysis, Analytical techniques, Maximum probable flood, Regional flood, River forecasting, Rainfall-runoff relationships, Flood protection, Flood control, Hydrology, Snowmelt, Meteorology, Statistical methods, Probability.
Identifiers: World Meteorological Organization.

Information is presented on methods of evaluation of meteorological conditions for estimation of maximum floods. Methods are given for estimating the extremes of rainfall and snowmelt on the basis of physical analysis, and for converting these into estimates of extreme flood flows. Statistical methods and their application to storm and flood events are discussed. Statistical analysis and techniques used in various countries in flood frequency analysis are outlined. The use of meteorological data in estimating flood frequencies is described. (Knapp-USGS)
W70-06535

SUMMARY REPORT STORMS OF 1969,
Los Angeles County Flood Control District, Calif.
Larry D. Simpson.
Los Angeles County Flood Control District Summary Report, June 1969. 55 p, 30 photo, 1 plate, 3 tab.

Descriptors: *Floods, *California, *Flood control, *Reservoirs, Peak discharge, Storm runoff, Urbanization, Flood protection, Channel improvement, Flood damage, Streamflow, Rainfall-runoff relationships, Stage-discharge relations.
Identifiers: Los Angeles County (Calif), Debris basins.

Data on flood-producing storms of 1969 in Los Angeles County, California, are tabulated. During the months of January and February of 1969, storms occurred over the southern California area which were of such a magnitude as to tax the capacities of a number of the facilities of the district and to cause significant damage to public and private property in those areas where complete flood protection had not yet been attained. These storms began with a two-phase storm which occurred between January 18 and 26, 1969, inclusive, followed by a storm which occurred between February 23 and 25, 1969. The effects of these storms on the Los Angeles County Flood Control District and the communities within Los Angeles County are discussed. (Knapp-USGS)
W70-06542

AVAILABILITY OF RAINFALL-RUNOFF DATA FOR PARTLY SEWERED URBAN DRAINAGE CATCHMENTS,
American Society of Civil Engineers, New York.
L. S. Tucker.
Available from the Clearinghouse as PB-191 755, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 13, Urban Water Resources Research Program, March 1970. 156 p, 24 fig, 15 tab, 49 ref. append. OWRR Project C-1536 (No 1992) (3).

Descriptors: *Data collections, *Rainfall-runoff relationships, *Cities, *Storm runoff, *Stream gages, Sewers, Open channels, Urbanization, Hydrologic data, Runoff, Drainage systems, Storm drains.
Identifiers: Japan, Urban runoff.

Available rainfall-runoff data for partially sewered urban drainage catchments are identified to facilitate model development by researchers. Information on the availability of rainfall-runoff data from 64 developed partially sewered urban drainage catchments in U.S. and 8 in Japan is summarized. The 64 catchments in the U.S. are concentrated in 8 states, and the locations of these in-

strumented catchments are shown by a map. Rainfall-runoff data for most of the catchments are available from the agencies collecting the data. A summary of information on the 64 instrumented, highly-developed, partially sewered urban drainage catchments in the U.S. is presented. Additional details such as availability of data, how to obtain further information about catchments and data, gage locations and maps of catchments are presented. (Knapp-USGS)
W70-06573

A STUDY OF THE HYDROLOGY AND GEOLOGY OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
For primary bibliographic entry see Field 02F.
W70-06705

2B. Precipitation

NON-METROPOLITAN DENSE RAINGAGE NETWORKS,
American Society of Civil Engineers, New York.
L. S. Tucker.
Available from the Clearinghouse as PB-191 709, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 11, Urban Water Resources Research Program, January 1970. 51 p, 15 fig, 8 tab, 19 ref. OWRR Project C-1536, Contract 14-01-0001-1992.

Descriptors: *Rain gages, *Networks, Rainfall-runoff relationships, Urbanization, Hydrology, Data collections, Hydrologic data, Instrumentation, Gaging stations.
Identifiers: Urban hydrology.

Information on 13 dense recording rain gage networks located in nonmetropolitan areas of the United States is summarized. The 13 networks are located in 8 states. Data reduced and recorded on punch cards or magnetic tape for most of the networks. Rainfall data for all networks are available, although arrangements for obtaining data will vary considerably with the source and inquiries should be made to the organizations involved. Only 6 of 13 networks are still in operation. Locations of 15 of the 20 largest U.S. cities operating rain gages are shown on a map. Information on the 13 dense rain gage networks is tabulated. (Knapp-USGS)
W70-06317

REGIONAL DISCRIMINATION OF CHANGE IN RUNOFF,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-06346

TRITIUM CONCENTRATION IN PRECIPITATION, 1967-1968,
Southwestern Radiological Health Lab., Las Vegas, Nev.; and Southeastern Radiological Health Lab., Montgomery, Ala.
For primary bibliographic entry see Field 05B.
W70-06515

URBAN ENERGY BALANCE CLIMATOLOGY,
California Univ., Los Angeles. Dept. of Geography.
Werner H. Terjung.
The Geographical Review, Vol 60, No 1, p 31-53, January 1970. 23 p, 16 fig, 23 ref.

Descriptors: *Climatology, *Cities, *Energy budget, *Heat balance, Heat budget, Albedo, Evaporation, Environment, Humidity, Meteorology, California, Precipitation (Atmospheric), Air temperature, Urbanization, Roads, Topography, Ecology.
Identifiers: Urban climatology, Los Angeles (Calif).

A pilot study of urban energy balance climatology covered only a part of a large city, Los Angeles, to test the feasibility of a large-scale approach in which traditional parameters were observed. An attempt was made to record some of the energy-balance components of the city and the human interface. A remote sensing mission by NASA covered part of the area. According to aerial photographs the largest percentage of the area was in concrete or concrete-like materials (including many roofs). The second major surface cover was light-colored blacktop. The observed parameters appear to have distinct patterns in relation to the downtown business district, the industrial-commercial zone and freeways, and the residential areas. A 'net radiation island' was caused by the shadow effect of tall buildings, which caused low surface and terrain temperatures. Residential areas exhibited higher net radiation than the industrial zone but less than the business district. Parking areas had large differences between air temperature and actual surface temperature. Net radiation was disposed of mainly as sensible heat flux (about 80%) and heat flux into the ground (about 20%). Low air temperatures and low values of the net radiation of the human interface generally did not coincide. (Knapp-USGS)
W70-06516

ESTIMATION OF MAXIMUM FLOODS.
For primary bibliographic entry see Field 02A.
W70-06535

PROJECT SKYWATER,
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.
For primary bibliographic entry see Field 03B.
W70-06678

PROJECT SKYWATER, 1969 ANNUAL REPORT.
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.
For primary bibliographic entry see Field 03B.
W70-06703

2C. Snow, Ice, and Frost

FINAL REPORT ON INVESTIGATION OF DESALINATION BY FREEZING,
Westinghouse Research Labs., Pittsburgh, Pa.
For primary bibliographic entry see Field 03A.
W70-06335

SWAMP VEGETATION-AN INDICATOR FOR NON-FROZEN AREAS IN THE NORTHERN TAIGA OF WESTERN SIBERIA,
A. P. Tyrmikov.
Available from Clearinghouse as AD-692 523. U.S. Army Foreign Science and Technology Center Technical Translation HT-23-741-68, 1968. 10 p, 7 tab, 8 ref. Translation of Akad, Nauk sssr, 1963, p 62-71.

Descriptors: *Swamps, *Vegetation effects, *Tundra, *Terrain analysis, Freezing, Thawing, Frozen ground, Permafrost, Arctic, Cold regions, Frozen soils, Subarctic, Topography, Aquatic environment, Marshes, Surface waters.
Identifiers: Taiga, Swamp vegetation, USSR.

In the northern taiga of Western Siberia, swamp vegetation can be used to determine the location of frozen and non-frozen areas. The type of vegetation is determined by: (1) the presence or absence of water on the surface of swamps; (2) the presence or absence a permanently-frozen layer of soil. Surface water in the swamps is a critical factor in thaw, freeze, and temperature of the soil. A number of factors cause variations in the depth and time of thawing and freezing, keeping the swamps in a state of change. Changes in water levels cause variation in the amount of surface water, the depth of thaw and freeze, and the vegetation. (Knapp-USGS)
W70-06396

ORIGIN AND ENVIRONMENTAL SI NIFICANCE OF LARGE-SCALE PATTERNE GROUND, DONNELLY DOME AREA, ALASK
Cold Regions Research and Engineering La Hanover, N.H.
Richard E. Church, Troy L. Pewe, and Marvin J. Andresen.
Available from the Clearinghouse as AD-474 4 $3.00 in paper copy, $0.65 in microfiche. Resear Report 159, June 1965. 78 p, 34 fig, 18 ref.

Descriptors: *Permafrost, Tundra, *Alas *Frozen ground, Climatology, Structural geolo *Silts, Sediments, Arctic, Melting, Stratigraphy. Identifiers: Donnelly Dome Area (Alas), Polygon

Large-scale patterned ground in the Donne Dome are of central Alaska consists of polygons to 46 m in diameter bounded by shallow trough to 2 m wide that form the sides of the polygons. T troughs are underlain by wedge-shaped masses sediments that extend downward 2 to 3 m. Textu of the sediments of the wedges is distinct from t of the poorly stratified glacial outwash gravel t the wedges transect. Sediments of the wedge v texturally along the strike and vertically withi given wedge. The coarsest material in the wedg about 75 mm in diameter, which is the same size the coarsest material in the outwash. The f material in the wedges is silt, the same as that wh blankets the area. The patterned ground of Donnelly Dome area originated during Wiscon time when the mean annual air temperature wa least 3C colder than now. With the warming of climate in post-Wisconsin time most of the peren ally frozen gravel thawed and the ice wed melted. The voids created by the melting of the wedges were filled with sediment that was wash from the surface or collapsed from the thawed si of the voids. The troughs bounding the polyg are now, however, no longer underlain with wedges but with ice wedge pseudomorphs (fo ice wedges). (Author)
W70-06454

STRENGTH DATA ON LAKE ICE,
Army Cold Regions Research and Enginee Lab., Hanover, N.H.
Guenther E. Frankenstein.
Available from the Clearinghouse as PB-163 6 $3.00 in paper copy, $0.65 in microfiche. Tec cal rept. 80 SIPRE-022.02.033, Jan. 61, 23 p. 5 5 tab, 2 ref.

Descriptors: *Ice, *Iced lakes, *Snow, *Stren Solar radiation, Test procedures, Michigan.
Identifiers: Portage Lake, Chassel Bay, Kewee Bay, Lake Superior.

Results are reported of 245 in-place suppo beam tests and 56 in-place cantilever beam t conducted during the 1957-58 winter on clea and a combination of clear and snow-ice f Chassel and Keweenaw Bays (Mich.). The ported beams had a higher computed flex strength than similar cantilever beams. The flex strength of the supported beams with the sur layer in tension was always higher than the ported beams with the bottom layer in tension reported earlier, the flexural strength of cantil beam tests was highest when the bottom layer in tension. On a clear day with air and ice temp tures near 0C, ice strength will decrease by as m as 6 times from morning to mid-aft. The te equipment is illustrated, summary data are t lated and graphed, and results of individual are appended.
W70-06455

VARIATION OF SOME MECHANICAL P PERTIES OF POLAR SNOW, CAMP CENTU GREENLAND,
Army Cold Regions Research and Engine Lab., Hanover, N.H.
Austin Kovacs, W. F. Weeks, and Frank Michi

REL Research, Rept no. CRREL-RR-276, nover, N.H. Dec. 69, 35 p.

scriptors: *Snow surveys.
ntifiers: *Snow density, Snow mechanical pro-rties, Camp Century, Greenland *Snow strength t.

e present study analyzes the results of a large nber of measurements of the unconfined com-ssive strength of polar snow from Camp Centu- Greenland, where it was possible to obtain sam-s with densities varying over essentially the nplete natural density range for polar snow and . The loading apparatus used was designed cifically for the purpose. The variations of the tic Young's modulus and the ring-tensile ength of the snow and ice were also studied.
70-06464

D. Evaporation and Transpiration

FECT OF IRRIGATION FREQUENCY ON IE AVERAGE EVAPOTRANSPIRATION FOR ARIOUS CROP-CLIMATE-SOIL SYSTEMS,
ah State Univ., Logan.
L. Norero, J. Keller, and G. Ashcroft.
p No 69-723, 1969 Winter Meet, Amer Soc Agr g, Chicago, Ill, Dec 1969. 21 p, 6 fig, 1 tab, 23 .

scriptors: Irrigation, *Irrigation practices, vapotranspiration, Soil moisture, Consumptive e, Soil-water-plant relationships, Soil water, Ef-cts, *Crops, Time, Bibliographies, Corn (Field), falfa, Lysimeters, Climates, Curves, Climatic ta.
entifiers: Potential evapotranspiration.

formula was developed and tested describing the lationship between evapotranspiration and soil oisture as affected by irrigation frequency, taking o account various effects of the interacting crop-mate-soil systems. Examples are given and the al development of curves was produced from ld crop data found in literature. Data selected re for corn grown in shallow field lysimeters and ep rooted field alfalfa to demonstrate rather ex-me cases in terms of the irrigation frequency quired for maintaining a relative productivity. he usefulness of these curves for designing irriga-n systems and developing irrigation scheduling actices was discussed. (USBR)
70-06380

OIL WATER EVAPORATION, ISOTHERMAL IFFUSION, AND HEAT AND WATER RANSFER,
wa State Univ., Ames.
r primary bibliographic entry see Field 02G.
70-06523

E. Streamflow and Runoff

YDROLOGICAL REGIONS IN SCANDINAVIA ND FINLAND,
wedish Meteorological and Hydrological Inst., ockholm. Hydrological Div.
agnar Melin.
ordic Hydrology, Vol 1, No 1, p 5-37, 1970. 33 p, 2 fig, 7 tab, 21 ref.

escriptors: *Regional analysis, *Streamflow, Regime, *Rainfall-runoff relationships, Discharge Water), Hydrologic data, Regions, Topography, limates, Precipitation (Atmospheric), Statistical ethods.
dentifiers: *Scandinavia, *Finland.

he rivers of Scandinavia and Finland are studied ith regard to regime, regional distribution, and ng-term variations in discharge. The regime stu-ies are based on monthly mean coefficients, that is he relation between the monthly means and the average annual discharge for a 30-year period. Within the two main areas of nival highland and lowland regime and Atlantic snow and rain regime, different local regime types were studied. The regional distribution was estimated with correlation coefficients and relations between means for one year expressed as a percentage of the mean discharge of 1931-60. The variations of 30- and 10-year mean discharge were studied by the method of moving averages from the year 1901. (Knapp-USGS)
W70-06326

FLOOD PLAIN INFORMATION OF CUMBERLAND RIVER, POOR, CLOVER, AND MARTINS FORKS, AND CATRON CREEK, HARLAN, KENTUCKY.
Army Corps of Engineers, Nashville, Tenn.
For primary bibliographic entry see Field 04A.
W70-06328

USE OF DIGITAL COMPUTERS IN PROCESSING, PUBLISHING, AND ANALYZING HYDROLOGIC DATA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-06329

EVALUATION OF THE SURFACE-WATER DATA PROGRAM IN KANSAS,
Geological Survey, Lawrence, Kans. Water Resources Div.
For primary bibliographic entry see Field 07A.
W70-06330

APPLICATION OF RUN-LENGTHS TO HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. Saldarriaga, and V. Yevjevich.
Colorado State University Hydrology Paper No 40, April 1970. 56 p, 29 fig, 10 tab, 31 ref, append. NSF Grants GK-11444 and G-11564.

Descriptors: *Drought, *Probability, *Precipitation (Atomospheric), *Time series analysis, Stochastic processes, Discharge (Water), Runoff forecasting, Statistical methods, Regression analysis, Statistical models, Streamflow forecasting.
Identifiers: Theory of runs.

A method was developed for investigating time series structure by using the mean run-length parameter. This method is distribution free. Applications to selected annual precipitation series and annual runoff series demonstrate its feasibility. Analytical expressions were developed by which the probabilities of sequences of wet and dry years of specified lengths can be calculated when the basic hydrologic time series is either an independent or a dependent stationary series of a variable which follows the first-order linear autoregressive model. Numerical values of probabilities of run-lengths may be obtained by the digital computer integration of expansion equations for run-length probabilities of the first-order linear autoregressive model. A set of tables and a set of graphs are presented to make the numerical values readily usable. Probabilities of run-lengths of dependent variables with a common distribution are also distribution free. This method and several applications are based on the premise that run-lengths, as statistical properties of time series, represent useful parameters in studying droughts and surpluses. (Knapp-USGS)
W70-06332

SIMILARITY IN UNLINED IRRIGATION CANAL SYSTEMS,
Southampton Univ. (England). DEPT. OF Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-06333

FLUVIAL PHYSIOGRAPHY AS A FACTOR IN BASIN RESPONSE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-06345

REGIONAL DISCRIMINATION OF CHANGE IN RUNOFF,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Viboon Nimmannit, and Hubert J. Morel-Seytoux.
Colorado State University Hydrology Paper No 37, November 1969. 40 p, 12 fig, 65 tab, 39 ref. USBR Contract No BR-14-06-D-6597.

Descriptors: *Runoff forecasting, *Weather modification, Water supply, Statistical methods, Streamflow forecasting, Colorado River basin, Water resources development, River basin development.
Identifiers: Precipitation management, San Juan Mountains (Colo).

Appropriate statistical tests for regional target-control techniques of evaluation is a suitable method for reduction of an originally large number of variables, and a choice between the Upper Basin of the Colorado River or the San Juan Mountains as a more suitable area of precipitation management operations were studied. The T-squared test is appropriate for multiple target-control techniques of evaluation. Canonical analysis is suitable for the reduction of a large number of original variables. The Upper Basin of the Colorado River is preferable under the assumption of an equal percentage of increase in runoff. However, if the percentage increase in the southern area is at least 1.2 times as large as in the northern area (and recent publications suggest that this ratio is probably around 3) then the southern area is preferable. The minimum number of years for detecting an increase of 10 percent in spring runoff was calculated to be 3 years in the Upper Basin of the Colorado River, and 4 years in the San Juan Mountains. (Knapp-USGS)
W70-06346

FLOOD HAZARD INFORMATION, SANTA CRUZ RIVER, SANTA CRUZ COUNTY, ARIZONA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W70-06347

FLOOD PLAIN INFORMATION, ANAHOLA, KAUAI, HAWAII.
Corps of Engineers, Honolulu, Hawaii.
For primary bibliographic entry see Field 04A.
W70-06348

COMPILATION OF HYDROLOGIC DATA, ELM FORK TRINITY RIVER, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 54 p, 2 fig, 6 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: *Elm Fork Trinity River (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 46.0-square-mile area above the stream-gaging station Elm Fork Trinity River near Muenster, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on maps. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow

at downstream points; to determine the effect of the structures on the sediment yield of the basin and to determine the trap efficiency of the structures; to develop computation techniques that will provide more accurate estimates of runoff resulting from a given amount of rainfall on small watersheds; and to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures. (Knapp-USGS)
W70-06350

FLOODS IN HAMPSHIRE QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Oak Park, Ill.
For primary bibliographic entry see Field 06F.
W70-06351

DETERMINATION OF THE MANNING COEFFICIENT FROM MEASURED BED ROUGHNESS IN NATURAL CHANNELS,
Geological Survey, Menlo Park, Calif.
J. T. Limerinos.
Geological Survey Open-file Report, June 1969. 79 p, 9 fig, 5 tab, 28 ref.

Descriptors: *Mannings equation, *Open channel flow, *Alluvial channels, *California, *Roughness (Hydraulic), On-site investigations, Particle size, Bottom sediments, Gravels, Statistical methods, Mathematical studies.
Identifiers: Bed roughness (Hydraulic).

The hypothesis that basic values of the Manning roughness coefficient of stream channels may be related to (1) some characteristic size of the streambed particles and (2) the distribution of particle size was tested by field determination of stream characteristics. The investigation was confined to channels with coarse bed material to avoid the complication of bed-form roughness in channels composed of fine bed material. Fifty current-meter measurements of discharge and appropriate field surveys were made at 11 sites on California streams for the purpose of computing the roughness coefficient, n, by the Manning formula. The test sites were selected to give a wide range in average size of bed material, and the discharges and surveys were made at such times as to provide data covering a suitable range in stream depth. The relations best fitting the field data were obtained by using either a characteristic particle diameter equal to the 84-percentile size or a diameter obtained by weighting three characteristic particle sizes. (Knapp-USGS)
W70-06352

HYDROLOGIC RECONNAISSANCE OF DEEP CREEK VALLEY, TOOELE AND JUAB COUNTIES, UTAH, AND ELKO AND WHITE PINE COUNTIES, NEVADA,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02F.
W70-06355

STUDY ON THE LONGITUDINAL PROFILE OF RIVER BED (JAPANESE),
Public Works Research Inst., Tokyo (Japan).
For primary bibliographic entry see Field 02J.
W70-06356

FLOOD PLAIN INFORMATION, NORTH BRANCH BIG TIMBER CREEK, CAMDEN COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 4A.
W70-06359

HYDROLOGIC RECONNAISSANCE OF RUSH VALLEY, TOOELE COUNTY, UTAH,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02F.
W70-06364

HYDROLOGIC RECONNAISSANCE OF CURLEW VALLEY, UTAH AND IDAHO,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02F.
W70-06365

FLOOD HYDROLOGY OF SMALL WATERSHEDS: EVALUATION OF TIME PARAMETERS AND DETERMINATION OF PEAK DISCHARGE,
Hawaii Univ., Honolulu.
I-pai Wu.
Trans Amer Soc Agr Eng, Vol 12, No 5, p 655-663, Sept-Oct 1969. 7 p, 14 ref, 2 tab, 19 ref.

Descriptors: *Peak discharge, *Small watersheds, *Watersheds (Basins), Hawaii, Time, Time lag, *Hydrographs, Recession curves, Hydrologic data, Hydrology, *Rainfall-runoff relationships, Flood hydrographs, Rainfall, Infiltration, Bibliographies.
Identifiers: *Flood hydrology, Instantaneous unit hydrogra, Oahu, Hawaii, *Peak runoff, Linearity.

Results are reported of the evaluation of time parameters and determination of peak discharge for more than 250 flood hydrographs from about 30 small Hawaiian watersheds. The typical characteristics of these watersheds are small size, steep slope, and high infiltration. The relationship between peak discharge and runoff is linear for a given watershed regardless of intensity, duraton, and size of the storm. The time to peak varies slightly from different hydrographs, but will not change the general shape of the hydrograph or the linearity of the peak discharge and runoff relation. Two hydrograph time parameters, time to peak and recession constant, are small and of nearly the same magnitude. Watershed area is the most significant factor in estimating the recession constant and is the dominant factor in determining flood-peak discharge. A simple, instantaneous unit hydrograph is applicable because flood hydrographs are produced by short-duration, high-intensity storms having the characteristic of linear storage of recession flow. A simple, peak-flow equation was derived, based on streamflow records with areas ranging from 0.2 to 10 sq mi. (USBR)
W70-06371

TURBULENCE IN THE MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-06382

SOME CHARACTERISTICS OF MACRO-TURBULENCE IN FLOW PAST A NORMAL WALL,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-06383

THE TURBULENT STRUCTURE OF OPEN RESTRICTED DEPTH FLOW WITH INTERFACE,
Akademiya Nauk URSR, Kiev.
For primary bibliographic entry see Field 08B.
W70-06384

A COMPUTATIONAL INVESTIGATION OF IMPULSIVELY-GENERATED EDDIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-06386

MACRO-TURBULENCE MEASUREMENTS IN NATURAL STREAMS,
Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics.
Vladimir Jezdinsky, Jan Cakrt, Miroslav Rudis, and Rados Smutek.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B38 323-332, 1967. 10 p, 8 fig, 16 ref.

Descriptors: *Turbulence, *Open channel flo *Streamflow, *Vortices, *Eddies, Turbulent flo Instrumentation, Flowmeters, Flow measureme Hydraulics, Current meters, Water measurement
Identifiers: *Macroturbulence, Turbulence mete

A device for measuring macroturbulence in natu streams is described and the results of its use discussed. The device is based on the principle combined Prandtl's and yaw tubes connected w two sensitive differential pressure transducers capacitive type with a thin rubber diaphragm a detecting element. The instrument measures fl tuating absolute values and vertical deviations the velocity vector. Those quantities are record by a two-channel tape-recorder and, evaluated longitudinal and lateral velocity-component fl tuations, give arbitrary statistical characterist especially turbulent intensities of both veloc components and their integral time-scales. Th characteristics are presented as functions of relative depth. (Knapp-USGS)
W70-06387

LARGE EDDIES IN STRATIFIED FLOW,
Central Research Inst. of Electric Power Indus Tokyo (Japan).
For primary bibliographic entry see Field 08B.
W70-06394

APPLICATION OF COMPUTER TECHNIQU TO SEEPAGE-SALINITY SURVEYS IN KA SAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 07C.
W70-06508

QUANTITY AND QUALITY OF LOW FLOW THE PECOS RIVER BELOW GIRVIN, TEX FEBRUARY 6-9, 1968,
Geological Survey, Austin, Tex.
V. L. Spiers, and H. R. Hejl, Jr.
Texas Water Development Board Report February 1970. 14 p, 2 fig, 3 tab, 3 ref.

Descriptors: *Low flow, *Discharge (Wat *Water quality, *Texas, Chlorides, Solu Streamflow, Data collections, Hydrologic data.
Identifiers: *Pecos River (Tex).

During the period February 6-9, 1968, w discharge in the Pecos River increased from cfs (cubic feet per second) near Girvin, Texa 134 cfs near the mouth. The discharge meas ments show four major gains, three major los and numerous smaller gains and losses between dividual sites. The quality of water impro progressively downstream, with dissolved so decreasing from 15,600 mg/l (milligrams per li to 1,720 mg/l. The chloride concentra decreased from 6,480 mg/l to 650 mg/l. (Kna USGS)
W70-06511

WATER-LOSS STUDIES OF LAKE COR CHRISTI, NUECES RIVER BASIN, TEX 1949-65,
Geological Survey, Austin, Tex.
C. R. Gilbert.
Texas Water Development Board Report January 1970. 11 p, 3 fig, 1 tab, 4 ref.

Descriptors: *Reservoirs, *Texas, *Bank stor *Surface-groundwater relationships, Recha Aquifers, Sands, Streamflow, Water loss, W storage.
Identifiers: Lake Corpus Christi (Tex), Nu River (Tex).

In April 1958 Lake Corpus Christi, which dr 16,656 square miles and is in south-central T on the Nueces River, was enlarged. This enla

nt increased the elevation of the conservation
ol by 20 feet and increased the potential inun-
ed area by almost 30 sq mi (old lake surface
a was about 9 sq mi). A cursory analysis of
ords of inflow to, change of contents in, and out-
w from the lake after 1958 showed large losses
surface water in the reach studied. Past analyses
overbank flooding on the Nueces River much
ther upstream have shown large water losses to
wide flood plain. The unaccounted for surface-
ter loss during 1958, most all of which occurred
er April, was computed to be 193,200 acre-ft. In
period April 1958 to December 1961 an unac-
unted for surface-water loss of 360,000 acre-ft
s computed. For the entire period of study after
oundment, April 1958 to September 1965, a
face-water loss of 497,000 acre-ft was com-
ed. Intermittent water levels were obtained by
Texas Water Development Board at 4 ground-
ter wells near the lake from September 1956 to
rch 1965. The 4 wells were located 300, 500,
00, and 6,200 feet from the shoreline of the
wly formed reservoir. All the wells were
ened in the Goliad Sand. During the period
58-61, the average rise in water level in the 4
lls was about 17 ft. This groundwater gain com-
es closely with the computed surface-water loss
360,000 acre-ft for the same period. A general
ession of the lake level began in late 1961 and
ntinued until May 1963. The 4 groundwater
lls also reflected this general recession. (Knapp-
GS)
70-06512

**ESEARCH ON SLEEPERS RIVER AT DAN-
LLE, VERMONT,**
ricultural Research Service, Plainfield, Vt.
r primary bibliographic entry see Field 04D.
70-06519

**ATER RESOURCES IN THE BIG LOST
VER BASIN, SOUTH-CENTRAL IDAHO,**
ological Survey, Boise, Idaho.
r primary bibliographic entry see Field 03B.
70-06529

**LOODS OF APRIL-MAY 1969 IN UPPER MID-
ESTERN UNITED STATES,**
ological Survey, St. Paul, Minn.
avid B. Anderson, and Harlan H. Schwob.
ological Survey Open-file report, February
70. 555 p, 61 fig, 11 tab, 7 ref.

escriptors: *Floods, *Mississippi River basin,
nowmelt, North Dakota, South Dakota, Min-
sota, Wisconsin, Iowa, Illinois, Snowpacks,
ofiles, Streamflow, Stage-discharge relations,
diment load, Meteorology, Frequency analysis,
scharge (Water), Data collections, Hydrologic
ta.
entifiers: Upper Midwest (USA).

he 1969 spring floods in upper Midwestern
ited States can be attributed primarily to an ex-
ptionally heavy blanket of snow. March
ecipitation was light, but at the end of the month
ter content of snow on the ground was as much
8 inches in some parts of the area. Flood data are
esented for 285 gaging sites in this report. Peak
ges and discharges exceeded previous known
axima in the upstream tributaries of the Red
ver of the North, upper Minnesota River basin,
pper basin of West Fork Des Moines River, and
e James, Vermillion, and Big Sioux River basins.
ecurrence intervals exceeded 50 years for 71 of
e 178 sites for which recurrence intervals were
mputed. Aerial photography during the flood
as obtained in a number of river basins. Flood
mages were estimated to be about $147 million.
ore than a million acres of rich agricultural land
ere inundated, and thousands of culverts and
idges were washed out. (Knapp-USGS)
70-06530

EXTENT AND FREQUENCY OF FLOODS IN THE BEDEN BROOK BASIN IN SOMERSET AND MERCER COUNTIES, NEW JERSEY,
Geological Survey, Trenton, N.J.
Thomas G. Ross.
Geological Survey Open-file report, June 1969. 51 p, 21 fig, 2 plate, 5 tab, 17 ref.

Descriptors: *Floods, *New Jersey, Frequency analysis, Cross-sections, Profiles, Hydrographs, Hydrologic data, Data collections, Stage-discharge relations, Streamflow, Flood protection, Zoning.
Identifiers: Beden Brook (NJ).

Data are presented on the areal extent, depth, and frequency of flooding in the Beden Brook basin, New Jersey and are intended to provide the basic data needed for the optimum use and most economic development of the flood plain. Proper use of the data in these reports will aid planning and zoning boards, engineers, architects, and land owners in promoting flood-plain land uses that are compatible with the flood risks involved. (Knapp-USGS)
W70-06533

ESTIMATION OF MAXIMUM FLOODS.
For primary bibliographic entry see Field 02A.
W70-06535

FLOODS IN OHIO, MAGNITUDE AND FREQUENCY, A SUPPLEMENT TO BULLETIN 32,
Geological Survey, Columbus, Ohio.
William P. Cross, and Ronald I. Mayo.
Ohio Department Natural Resources, Division of Water Bulletin 43, April 1969. 230 p, 5 plate, 3 tab, 2 ref.

Descriptors: *Floods, *Frequency analysis, *Ohio, Streamflow, Flood forecasting, Stream gages, Data collections, Hydrologic data, Stage-discharge relations, Discharge measurement.
Identifiers: Flood frequency.

Flood-frequency curves were drawn for all stations in Ohio having more than 15 years of record. The required length of record was reduced to 10 yr for small-area stations (less than 30 sq mi), and the curves for the shorter records were adjusted to the 1921-65 base period by comparison with nearby long-term records. The adjusted mean annual floods were used in the regional analysis for determining floods on ungaged areas. The magnitudes of the 20- and 50-yr recurrence interval floods for each station were reduced to a ratio by dividing by the mean annual flood. This ratio is seen to be larger for small-area streams than for large-area streams, and this relationship applies to all Ohio flood records. The years of record collected since 1956 did not appreciably change the shapes of the 1956 frequency plots. The plots generally are close to a straight line on Gumbel frequency paper, but some deviate either above or below a straight line introducing uncertainties in extrapolation beyond the period of record. (Knapp-USGS)
W70-06536

SUMMARY REPORT STORMS OF 1969,
Los Angeles County Flood Control District, Calif.
For primary bibliographic entry see Field 02A.
W70-06542

ELECTRONIC COMPUTATION OF WATER LEVELS IN RIVERS DURING HIGH DISCHARGES.
Netherlands Rijkswaterstaat, The Hague.

Rijkswaterstaat Communications No 9, The Netherlands, 1969. 28 p, 7 fig, 8 photo.

Descriptors: *Stage-discharge relations, *Deltas, *Mathematical studies, *Channel morphology, Flood forecasting, Flood protection, Routing, Digital computers, Equations, Chezy equation, Weirs, Flood plains.
Identifiers: *Netherlands, Rhine River.

Digital computer methods are discussed for determining stage-discharge relations as modified by natural and manmade changes in channel morphology. The methods are used primarily to calculate flood risk changes in new hydrological projects and for flood protection works design. (Knapp-USGS)
W70-06546

HYDROLOGICAL ATLAS OF CANADA.
National Research Council of Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 07C.
W70-06547

WATER RESOURCES DEVELOPMENT IN MONGOLIA.
Economic Commission for Asia and the Far East (UN), New York.

Water Resources Journal, United Nations Economic Commission for Asia and the Far East (ECAFE), p 1-24, September 1969. 24 p, 7 fig, 11 tab.

Descriptors: *Water resources development, *Planning, *Groundwater, *Surface waters, Arid lands, Water supply, Water yield, Reservoirs, Water wells, Water utilization, Irrigation, Municipal water, Hydroelectric power.
Identifiers: *Mongolia.

The present state of water resources development in Mongolia is reviewed and plans for future development are outlined. Mongolia is located in an arid zone. The average annual precipitation varies from around 40 mm in the southern part of the country to 400 mm in the northern part. The amount varies considerably from year to year, especially in the north. In spite of the fact that Mongolia on the whole receives little precipitation, heavy rainfall sometimes occurs during the warm season. The mean annual river discharge varies from 0.1 to 1.0 liter/sec/sq km in plateau and desert areas and from 20 to 60 liter/sec/sq km in mountain areas. The runoff coefficient is low, varying from 1 to 50%. The groundwater potential is considerable, amounting to about half the total surface runoff. Groundwater exists at varying depths as perched and artesian aquifers as well as unconfined aquifers. (Knapp-USGS)
W70-06548

GEOLOGY AND GROUNDWATER RESOURCES OF THE MORGANTON AREA, NORTH CAROLINA,
Geological Survey, Raleigh, N.C.
For primary bibliographic entry see Field 02F.
W70-06575

WATER RESOURCES OF WISCONSIN, ROCK-FOX RIVER BASIN,
Geological Survey, Washington, D.C.
R. D. Cotter, R. D. Hutchinson, E. L. Skinner, and D. A. Wentz.
Geological Survey Hydrologic Investigations Atlas HA-360, 4 sheets, 1969. Text, 19 fig, 4 chart, 3 tab, 25 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Wisconsin, Water supply, Water yield, Aquifers, Streamflow, Water quality, Water wells, Water levels, Hydrologic budget, Lakes, Streams, Water utilization.
Identifiers: Rock-Fox River basin (Wis).

The physical environment, availability, distribution, characteristics, movement, quality, water problems, and use of water within the Rock-Fox River basin, Wisconsin are described in order to aid in planning future water management within the basin. General information is given on the basin, derived from data obtained from Federal, State, and local agencies. In addition, new data were col-

lected from areas where available data were scarce. The RockaFox River basin covers about 4,750 square miles in the southeastern part of the State. Large amounts of good quality water are available in the Rock-Fox River basin. Of the 31.4 inches of average annual precipitation that falls on the basin, about 6.6 inches or 1,500 mgd runs off as streamflow. Groundwater is available from 4 aquifers in the basin: the sandstone aquifer, the Platteville-Galena aquifer, the Niagara aquifer, and the sand and gravel aquifer. Any of these aquifers is capable of yielding domestic and stock supplies. The sandstone aquifer commonly yields over 1,000 gpm to wells, as does the sand and gravel in the lower Rock River valley. Both ground- and surface water have high natural hardness; high iron content is a local problem in groundwater. Some lakes and reaches of streams are polluted by industrial, municipal, or domestic wastes, rendering them less useful as wildlife habitat and for recreational purposes. Two potential problems are flooding and pollution of the artesiam system. Data are presented in maps scaled 1:1 million, block diagrams, cross sections, graphs, charts, tables, and text. (Knapp-USGS)
W70-06577

A NOTE ON THE STEADY TWO-DIMENSIONAL FLOW OF A STRATIFIED FLUID OVER AN OBSTACLE,
Melbourne Univ., Parkeville (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 08B.
W70-06647

ON STRATIFIED FLOWS OVER BOTTOM TOPOGRAPHY,
Harvard Univ., Cambridge, Mass.
S. J. Jacobs.
Journal of Marine Research, Vol 22, No 2, 1964, p 223-235, 5 fig, 8 ref.

Descriptors: *Stratified flow, *Streambeds, Thermal stratification, Fluid mechanics, Flow.

A rotating stratified fluid was bounded above by a horizontal plane and below by bottom topography in the form of a long ridge on a horizontal plane. Far upstream of the topography, the flow in the main body of the fluid is uniform and barotropic and is directed at right angles to the depth contours. The equations of motion are transformed so that temperature appears as an independent variable. For flow over a ridge of small topographic height, it is shown that the lee waves are of negligibly small amplitude when the Rossby number is small. If the terms giving rise to these waves are neglected, the governing equations in (x, y, T) coordinates are linear and can be used to study the flow over finite amplitude topography. A strong component of flow along the ridge is found irrespective of the degree of stratification. Stratification increases this component near the bottom of the fluid on the lee side of the ridge and decreases it on the upstream side. Topographic effects are not confined to a region near the bottom and are felt throughout the entire depth of the fluid. (Guerrero-Vanderbilt)
W70-06649

2F. Groundwater

GROUND-WATER CONDITIONS DURING 1968, VANDENBERG AIR FORCE BASE AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04B.
W70-06321

HYDROLOGY OF HUNGRY HORSE RESERVOIR, NORTHWESTERN MONTANA,
Geological Survey, Menlo Park, Calif.
W. D. Simons, and M. I. Rorabaugh.
Geological Survey Open-file Report, January 1970. 114 p, 29 fig, 40 tab, 9 ref.

Descriptors: *Reservoir operation, *Bank storage, *Surface-groundwater relationships, *Montana, Base flow, Groundwater movement, Water levels, Water utilization, Low flow, Data collections, Hydrologic data, Hydrogeology.
Identifiers: Hungry Horse Reservoir (Mont).

Thr existence of usable bank storage was established by a comptehensive water-budget analysis of Hungry Horse Reservoir for the period, October 1964 through April 1967. A theoretical model of the response of the aquifer adjacent to Hungry Horse Reservoir to changes in reservoir stage was developed. The constants used in the mathematical equations were based on the residuals from the water-budget computations. Computed groundwater storage in the alluvium adjacent to Hungry Horse Reservoir is 108,000 cfs-days between the elevations of 3,336 and 3,560 feet above mean sea level. This amount of added storage is not totally available as reservoir inflow under normal patterns of regulation because of the time lag and hysteresis-loop effects of groundwater movement across the interface between the aquifer and the reservoir. The amounts of groundwater inflow average about 60% of the corresponding groundwater storage. (Knapp-USGS)
W70-06323

GEOLOGY AND GROUNDWATER RESOURCES OF GRAND FORKS COUNTY, NORTH DAKOTA, PART 3-GROUNDWATER RESOURCES,
Geological Survey, Bismarck, N. Dak.
T. E. Kelly, and Q. F. Paulson.
North Dakota Geological Survey Bulletin 53 and North Dakota State Water Comm County Groundwater Studies 13, 1970. 58 p, 16 fig, 1 plate, 2 tab, 50 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *North Dakota, Water wells, Glacial drift, Sands, Gravels, Water yield, Transmissivity, Water quality, Water supply, Water levels, Data collections, Hydrologic data.
Identifiers: Grand Forks County (N Dak).

Groundwater is obtainable in Grand Forks County, North Dakota from the bedrock and from the overlying glacial drift deposits. Sustained yields of as much as 500 gallons per minute have been pumped from the Dakota Group in eastern Grand Forks County. Water from the bedrock aquifers generally is very saline. Five major aquifers in the glacial deposits were delineated by test drilling. The Elk Valley aquifer covers at least 200 square miles, and yields greater than 500 gpm are obtainable locally. The Inkster aquifer is small but contains water of excellent quality. Regional groundwater movement is eastward, and eastern Grand Forks County is part of a large artesian discharge area. Geochemical data indicate a progressive water quality change eastward across the county from a low-salinity calcium bicarbonate type to a high-salinity sodium sulfate chloride type. (Knapp-USGS)
W70-06337

GEOLOGY FOR PLANNING IN DE KALB COUNTY, ILLINOIS,
Illinois State Geological Survey, Urbana.
David L. Gross.
Illinois Geological Survey Environmental Geology Note No 33, April 1970. 26 p, 6 fig, 16 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Illinois, Water yield, Water quality, Sands, Gravels, Glacial drift, Sandstones, Dolomite.
Identifiers: De Kalb County (Ill).

The mineral and water resources of De Kalb County, Illinois are summarized in a report for use in planning the future growth of the county. Groundwater is available in De Kalb County for most purposes, including municipal, industrial, domestic, and livestock uses. Groundwater availability is controlled by the distribution, thickness, and character of the geologic units present in the county. The principal aquifers are sand and gravel in the unco solidated deposits and fractured limestone dolomite and permeable sandstone in the bedroc Sand and gravel aquifers in De Kalb County a widely distributed, both areally and verticall throughout the county, but in several areas they a absent or too thin. Sand and gravel occur pri cipally in the glacial meltwater channels which l along present drainageways or are buried und younger glacial deposits. Many domestic and far wells obtain water from dolomites in parts of t northern, central, and southeastern parts of t county where the drift cover is thicker. Whe sandstones occur directly below fairly thick, exte sive sand and gravel deposits, they may supply considerable amount of vertical recharge. This is highly favorable situation for the development large groundwater supplies. (Knapp-USGS)
W70-06338

AVAILABILITY OF WATER FOR ARTIFICIA RECHARGE, PLAINS GROUNDWATE MANAGEMENT DISTRICT, COLORADO,
Geological Survey, Denver, Col.
For primary bibliographic entry see Field 04B.
W70-06339

GEOLOGY AND GROUNDWATE RESOURCES OF WELLS COUNTY, NORT DAKOTA: PART III - GROUNDWATE RESOURCES,
Geological Survey, Bismarck, N. Dak.
Frank Buturla, Jr.
North Dakota Geological Survey Bull 51 and No Dakota State Water Comm County Groundwa Studies 12, 1970. 57 p, 18 fig, 2 plate, 1 tab, 35 r

Descriptors: *Water resources, *Groundwat *Aquifers, *North Dakota, Water wells, Glac drift, Sands, Gravels, Water yield, Transmissivi Water quality, Water supply, Water levels, D collections, Hydrologic data.
Identifiers: *Wells County (N Dak).

The residents of Wells County, North Dakota tain most of their water from aquifers in the glac drift and underlying Cretaceous rocks. Aquifers the glacial drift have the greatest potential for la groundwater withdrawals. Sand and gravel depo underlie surficial outwash plains and channels, a are found in buried valleys. Nine major d aquifers were mapped and described. Yields in cess of 500 gallons per minute are possible from New Rockford aquifer, a buried valley fill. Yie of as much as 500 gpm are obtainable in pla from the Manfred and Heimdal aquifers, and much as 250 gpm in other aquifers. In most part the county, some groundwater also is availa from Cretaceous rocks underlying the drift. Wa from the glacial drift aquifers is generally v hard, but only moderately saline. Most is suita for domestic and livestock use and also for irri tion use with good drainage. Water from Cretaceous rocks generally is soft, but rat saline. It is generally unsuitable for irrigation. napp-USGS)
W70-06340

GEOLOGY AND RELATED GROUNDWAT OCCURRENCE, SOUTHEASTERN MAS COUNTY, WASHINGTON,
Department of Water Resources, Olym Washington.
Dee Molenaar, and John B. Noble.
Washington Department of Water Resou Water-Supply Bulletin No 29, 1970. 145 p, 8 fi plate, 5 tab, 16 ref.

Descriptors: *Water resources, *Groundwa *Aquifers, *Washington, Glacial drift, Sa Gravels, Water wells, Water yield, Transmissi Water quality, Water supply, Water levels, D collections, Hydrologic data.
Identifiers: Mason County (Wash).

e northwestern part of Mason County, Washing-
lies in the Olympic Mountains and the
nainder lies in the Puget Sound lowland. The
undwater supplying most of the water needs in
lowland area is obtained principally from the
rser phases of Salmon Springs Drift, Skokomish
ivel, and Vashon Drift. The older undif-
entiated sedimentary deposits locally provide
ge yields to deep industrial and municipal wells.
annual precipitation at Shelton averages 64
hes. Most of the rainfall occurs from October to
y, and the summers are relatively dry. Water
els in wells are generally within 50 feet of land
face. Well yields range from less than 10 gpm to
re than 4,000 gpm. Present groundwater use is
ncipally for domestic and public supply. The
undwater is generally of good chemical quality.
ly 4 wells are known to have yielded water with
ardness of greater than 180 mg/l. Three wells
ld water with chloride content of greater than
) mg/l; this amount of chloride resulted from
-water encroachment from nearby marine
ters. As much as 1.6 mg/l of iron is present in
undwater locally, although the average iron
ntent of sampled waters is 0.14 mg/l. (Knapp-
GS)
70-06341

**SULTS OF WATER-RESOURCES IN-
STIGATIONS THROUGH 1968 IN YEL-
WSTONE NATIONAL PARK, WYOMING,**
ological Survey, Cheyenne, Wyo.
ward R. Cox.
ological Survey Open-file report, September
69. 87 p, 8 fig, 10 tab, 1 ref.

scriptors: *Water supply, *Groundwater, *Na-
nal Parks, *Wyoming, Water wells, Aquifers,
rveys, Investigations, Camp sites, Hydrogeology,
ta collections, Hydrologic data.
ntifiers: *Yellowstone National Park.

ter supply investigations in Yellowstone Na-
nal Park, begun in September 1966, include the
dy of water problems at selected sites and an
erall appraisal of water resources in the Park.
connaissance studies were made near selected
es. Test holes were augered; wells were con-
ucted and their yield characteristics determined
pumping tests. Fountain Paint Pot, Tower Junc-
n, Slough Creek campground, South Entrance,
ld Volcano, and Norris Junction have potential
undwater supplies. It seems doubtful that
undwater can be obtained to replace surface-
ter supplies now in use at Canyon Village and
mmoth. The overall quality of water for use at
mmoth would not be improved by changing the
int of diversion from Glen Creek to Lava Creek.
st water sampled to date is potable. Fluoride
ncentrations of groundwater and surface water
places, however, exceed the recommended limit
ablished by the U.S. Public Health Service. (K-
pp-USGS)
70-06354

**YDROLOGIC RECONNAISSANCE OF DEEP
REEK VALLEY, TOOELE AND JUAB COUN-
ES, UTAH, AND ELKO AND WHITE PINE
OUNTIES, NEVADA,**
ological Survey, Salt Lake City, Utah.
W. Hood, and K. M. Waddell.
ah Department of Natural Resources Technical
blication No 24, 1969. 54 p, 8 fig, 1 plate, 16
, 51 ref, append.

escriptors: *Water resources, *Surface waters,
Groundwater, *Utah, *Nevada, Arid lands, Water
lls, Water levels, Aquifers, Springs, Hydrogeolo-
, Data collections, Hydrologic data, Water quali-
Water resources development, Safe yield, Water
ld.
entifiers: Deep Creek Valley (Utah-Nev).

eep Creek Valley is a 281,000-acre north-trend-
g depression on the Utah-Nevada State line. The
own groundwater reservoir in the valley is in un-
nsolidated rocks, and underlies at least 32,000 acres. Nearly half of the 290,000 acre-ft of annual precipitation falls on the lowlands below an altitude of about 6,500 ft, and does little more than sustain soil moisture. Most runoff and recharge is derived from precipitation above 6,500 ft. The estimated average annual runoff from the uplands is 28,000 acre-ft. The estimated annual outflow from the valley, including some discharge from springs and seepage areas, is 2,000 acre-ft, or about 0.7% of the estimated volume of average annual precipitation in the drainage basin. The estimated average annual recharge to and discharge from the groundwater reservoir is 17,000 acre-ft. The amount of groundwater available for salvage from nonbeneficial discharge in Deep Creek Valley is estimated to be about 4,000 acre-ft. If 100 ft of saturated deposits in the groundwater reservoir were dewatered, the estimated volume of water that could be recovered would be 320,000 acre-ft. The range in the concentration of dissolved solids is 38-562 mg/l. Because existing stream and spring supplies appear to be fully appropriated, future additional development would have to depend on water from wells. (Knapp-USGS)
W70-06355

VARIATIONS IN THE CHEMICAL QUALITY OF GROUNDWATER BENEATH AN IRRIGATED FIELD, CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 02K.
W70-06358

THE YORK COUNTY GROUNDWATER WITHDRAWAL INVESTIGATION, 1968,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 04B.
W70-06360

WATER WELLS AND SPRINGS IN PANAMINT, SEARLES, AND KNOB VALLEYS, SAN BERNADINO AND INYO COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04B.
W70-06363

HYDROLOGIC RECONNAISSANCE OF RUSH VALLEY, TOOELE COUNTY, UTAH,
Geological Survey, Salt Lake City, Utah.
J. W. Hood, Don Price, and K. M. Waddell.
Utah Department of Natural Resources Technical Publication No 23, 1969. 63 p, 7 fig, 1 plate, 17 tab, 44 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Utah, Arid lands, Water wells, Water levels, Aquifers, Springs, Hydrogeology, Data collections, Hydrologic data, Water quality, Water resources development, Safe yield, Water yield.
Identifiers: Rush Valley (Utah).

Rush Valley, Utah is an elongated depression that covers about 250,000 acres and is part of a drainage basin that covers about 470,000 acres. The source of all water in Rush Valley is the 550,000 acre-feet of precipitation that falls mainly on the Oquirrh, Stansbury, Onaqui, and Sheeprock Mountains. The extimated maximum potential long-term average annual runoff from the uplands is 70,000 acre-ft of water. No surface water leaves the topographically closed valley. The estimated average annual groundwater recharge to and discharge from Rush Valley is in the range of 34,000-37,000 acre ft. Groundwater is discharged from the valley by wells, by evapotranspiration (including spring flow), and by subsurface outflow through the east edge of the valley. In 1966, wells discharged about 4,800 acre-ft of water. Evapotranspiration accounts for about 70% of the total groundwater discharge, and subsurface outflow accounts for about 14%. The estimated perennial yield of groundwater in Rush Valley is about 15,000 acre-ft. If water levels were lowered 100 ft, the estimated amount of recoverable water would be 1.6 million acre-ft. The range of concentrations of dissolved solids in water in the drainage basin is 200-2,180 ppm. The main use of the water has been for irrigation. In 1966, an estimated 5,800 acres were irrigated partly with surface water and supplemental groundwater and partly with groundwater alone. Groundwater is the main source of water for future development in the valley. (Knapp-USGS)
W70-06364

HYDROLOGIC RECONNAISSANCE OF CURLEW VALLEY, UTAH AND IDAHO,
Geological Survey, Salt Lake City, Utah.
E. L. Bolke, and Don Price.
Utah Department of Natural Resources Technical Publication No 25, 1969. 40 p, 4 fig, 2 plate, 6 tab, 27 ref.

Descriptors: *Water resources, *Groundwater, *Utah, Idaho, Water quality, Water yield, Water supply, Aquifers, Alluvium, Saline water, Water wells, Data collection, Hydrologic data, Hydrogeology.
Identifiers: Curlew Valley (Utah-Idaho).

The Curlew Valley drainage basin which extends across the Utah-Idaho State line lies between latitude 41 deg 40 min and 42 deg 30 min north and longitude 112 deg 30 min and 113 deg 20 min west, and covers about 1,200 sq mi. The valley is bounded on the west, north, and east by mountain ranges having peaks ranging from about 6,500 to nearly 10,000 ft above mean sea level, and is open to the south where it drains into Great Salt Lake. It is an arid to semiarid, largely uninhabited area, with community centers at Snowville and Kelton. Average annual precipitation is less than 8 inches on part of the valley floor and reaches a maximum that exceeds 35 inches on one of the highest mountain peaks. Confined aquifers in alluvial and lacustrine deposits and intercalated volcanic rocks in the valley fill yield several hundred to several thousand gallons of water per minute to individual large-diameter irrigation wells west of Snowville and near Kelton. Most of the groundwater in the western part of the subbasin is of suitable chemical quality for domestic supply and irrigation; some of the water in the eastern part is not of suitable chemical quality for these uses. Most of the water throughout the valley is suitable for stock use. A slight increase in the dissolved-solids content of the water withdrawn from wells near Snowville during recent years suggests that pumping has induced the upward movement of highly mineralized water from a deeper to a more shallow aquifer. Thus the ultimate quantity of groundwater may depend on the chemical quality of the groundwater. (Knapp-USGS)
W70-06365

GROUNDWATER RESEARCH IN THE U.S.A.,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 06B.
W70-06402

MILLERS RIVER BASIN, MASSACHUSETTS BASIC-DATA REPORT NO.11-GROUNDWATER SERIES,
Geological Survey, Boston, Mass.
For primary bibliographic entry see Field 04B.
W70-06405

A GEOPHYSICAL STUDY OF ALLUVIAL VALLEYS IN WESTERN MORA COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
Jerry W. Mercer, and Eric G. Lappala.
Geological Survey Open-file report, February 1970. 69 p, 34 fig, 1 tab, 4 ref.

Descriptors: *Seismic studies, *Groundwater, *Water levels, *Alluvium, *New Mexico, Surveys, Investigations, Water resources, Water yield, Aquifers, Water wells, Geophysics.
Identifiers: Seismic refraction studies.

The seismic-refraction method of geophysical prospecting was used in western Mora County to determine the saturated thickness of alluvial deposits in the valley of the Mora River and its tributaries. Seismic data indicate a maximum thickness of alluvial deposits of over 300 feet and a minimum thickness of less than 3 feet. Depths to the top of the saturated zone range from 0 to over 10 feet. (Knapp-USGS)
W70-06507

WATER-LOSS STUDIES OF LAKE CORPUS CHRISTI, NUECES RIVER BASIN, TEXAS, 1949-65,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-06512

WATER SUPPLY WELL SRC-2, STALLION RANGE CENTER, WHITE SANDS MISSILE RANGE, SOCORRO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04B.
W70-06513

GEOHYDROLOGY - PROJECT RULISON, GARFIELD COUNTY, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 08H.
W70-06517

HYDROLOGIC SITUATION NORTH OF SNIPES MOUNTAIN NEAR SUNNYSIDE, YAKIMA COUNTY, WASHINGTON,
Geological Survey, Tacoma, Wash
For primary bibliographic entry see Field 04B.
W70-06518

GEOHYDROLOGY OF THE CROSS-FLORIDA BARGE CANAL AREA WITH SPECIAL REFERENCE TO THE OCALA VICINITY,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04A.
W70-06534

GENERAL HYDROLOGY OF THE MIDDLE GULF AREA, FLORIDA,
Geological Survey, Tallahassee, Fla.
R. N. Cherry, J. W. Stewart, and J. A. Mann.
Geological Survey Open-file Report, 1969. 168 p, 45 fig, 4 tab, 34 ref.

Descriptors: *Hydrogeology, *Water resources, *Florida, Hydrologic budget, Groundwater, Surface waters, Springs, Groundwater movement, Streamflow, Aquifers, Water supply, Water utilization.
Identifiers: Middle Gulf Area (Fla).

The Middle Gulf area in the west-central coast of peninsular Florida encompasses about 1,700 sq mi. The area is drained principally by the Crystal, Homosassa, Chassahowitzka, Weekiwachee, Pithlachascotee and Anclote Rivers and Cypress Creek. The average daily discharge from the area for the period January 1964-June 1966, was 2,300 cfs. No permanent regional declines in surface or groundwater levels have occurred in the area. Principal outflow from the hydrologic system is evapotranspiration which amounts to about 67% of the total outflow. Runoff amounts to about 32% and direct groundwater outflow to the sea is about 1%. Rainfall averages about 55 inches annually. Eighty percent of the runoff from the area originates either as springflow or seepage to streams from the Floridan aquifer. The water-level gradients in the system are about the same as the topographic gradients (2-3 ft/mi). Water levels are highest in late summer or early fall following the rainy season and are lowest in late May or early June. The chemical quality of ground and surface water is good. Ample supplies of good quality water is good. Ample supplies of good quality water are available for existing and foreseeable uses. (Knapp-USGS)
W70-06540

TEST-WELL AND SOIL DATA, FORT MOHAVE INDIAN RESERVATION AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
Fred Kunkel.
Geological Survey Basic-data Compilation Report, August 1969. 77 p, 1 fig, 3 tab.

Descriptors: *Data collections, *Water wells, *Soils, *California, Hydrologic data, Sampling, Logging (Recording), Boreholes, Subsurface investigation.
Identifiers: Fort Mohave (Calif).

This report is a compilation of 115 lithologic logs of wells or test borings, water-level data in 14 wells, and particle-size distribution curves for eight soil samples in the Fort Mohave Indian Reservation area, California. These data were collected by the U.S. Geological Survey in 1968 and 1969 as part of a hydrologic study of the Fort Mohave Indian Reservation area as requested by the U.S. Bureau of Indian Affairs. (Knapp-USGS)
W70-06544

SUBSURFACE GEOLOGY OF THE LATE TERTIARY AND QUATERNARY WATER-BEARING DEPOSITS OF THE SOUTHERN PART OF THE SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
M. G. Croft.
Geological Survey Open-file Report, 1969. 29 p, 3 fig, 6 plate, 56 ref.

Descriptors: *Hydrogeology, *Aquifers, *California, Alluvium, Permeability, Transmissivity, Groundwater movement, Recharge, Artificial recharge, Aquicludes, Hydrology, Geology.
Identifiers: *San Joaquin Valley (Calif).

The southern part of the San Joaquin Valley, California is a borad structural trough of mostly interior drainage. Unconsolidated deposits blanket the underlying consolidated rocks in the valley and are the source of most of the fresh groundwater. Alluvium is composed of coarse arkosic deposits derived from the Sierra Nevada, Tehachapi, and San Emigdio Mountains. The coarse oxidized deposits of the alluvium are the most permeable aquifers along the eastern and southern margins of the valley. The coarse oxidized continental and alluvial deposits are the most permeable strata along the western margin of the valley and contain most of the fresh-water body. Artificial recharge will be more successful if sites are located in areas underlain by these deposits. Flood-basin, lacustrine, and marsh deposits, which are nearly impermeable, are chiefly aquicludes and do not transmit water fast enough to furnish an appreciable supply for a well. Lacustrine-clay tongues are virtually impermeable horizons that separate the alluvial sequence into several aquifers. (Knapp-USGS)
W70-06545

WATER RESOURCES DEVELOPMENT IN MONGOLIA.
Economic Commission for Asia and the Far East (UN), New York.
For primary bibliographic entry see Field 02E.
W70-06548

THERMAL SPRINGS OF THAILAND.
Kaset Pitakpaivan.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academ Prague, p 69-74, 1969. 6 p, 1 fig, 1 tab.

Descriptors: *Thermal waters, *Mineral wate *Springs, Aquifers, *Groundwater, Mappir Geology, Water temperatures, Igneous roc Limestones, Sandstones, Fissures (Geolog Water utilization.
Identifiers: *Thailand.

Thailand has 37 occurrences of thermal a mineral springs. The temperature of these sprir ranges from 29 to 100 deg C and their waters ca very small amounts of dissolved minerals, esp cially of sulfur. Geologically, the greatest numb of springs are distributed within the belt of young granites which form the core of the mountain ran in the whole length of western Thailand. T springs located in northern Thailand and the ea ern coast are utilized for therapeutic purpos (Gabriel-USGS)
W70-06551

THERMAL AND MINERAL SPRINGS SOUTH VIETNAM (FRENCH),
H. Fontaine.
In: Proceedings of Symposium II on Mineral a Thermal Waters of the World, B-Overseas Co tries, Vol 19, Report of 23rd Session of Inter tional Geological Congress, 1968, Acade Prague, p 63-68, 1969. 6 p, 3 fig, 1 tab, 5 ref.

Descriptors: *Thermal water, *Mineral wat *Springs, Groundwater, *Aquifers, Water te perature, Water chemistry, Mapping, Carbona Sulfates, Silica, Sodium, Potassium, Calcium, M nesium, Discharge (Water).
Identifiers: *South Vietnam.

About 50 occurrences of thermal and mine waters with temperatures ranging from 40 to deg. C are located in South Vietnam. The mine content of these waters does not exceed 6 g/l an the majority of cases is less than 1 g/l. Basaltic trusions and extrusions of Tertiary, to recent a may be considered as the primary source of th waters. The spring waters of South Vietnam may classified as follows: Sodium bicarbonates, bi bonates and sodium sulfates, chlorides, and ca um sulfates (Gabriel-USGS)
W70-06552

MINERAL AND THERMAL WATERS JAPAN,
Hisayoshi Nakamura.
In: Proceedings of Symposium II on Mineral Thermal Waters of the World, B-Overseas Co tries, Vol 19, Report of 23rd Session of Inte tional Geological Congress, 1968, Acade Prague, p 45-62, 1969. 18 p, 6 fig, 8 tab, 12 ref.

Descriptors: *Mineral waters, *Thermal wa *Springs, *Aquifers, *Groundwater, Geol Boreholes, Water chemistry, Water temperat Mapping, Pumping, Heat flow.
Identifiers: *Japan, Geothermal powerplants.

There are about 13,000 hot springs in Japan. N of these hot springs are distributed along Quate ry volcanic zones whose basement rocks ma consist of green tuff of Tertiary age. These sp waters contain considerable amounts of sulfates, carbonates, Na, K, Al, Fe, and silic The hot springs are widely used in Japan therapeutic treatment, bathing, and geothe power generation (Gabriel-USGS)
W70-06553

MINERAL AND THERMAL WATERS OF DIA,
G. C. Chaterji.
In: Proceedings of Symposium II on Mineral Thermal Waters of the World, B-Overseas C tries, Vol 19, Report of 23rd Session of Int tional Geological Congress, 1968, Acad Prague, p 21-43, 1969. 23 p, 5 plate, 3 tab, 7 re

criptors: *Mineral water, *Thermal water, rings, *Aquifers, *Groundwater, Geology, pping, Water temperature, Water chemistry, rogen sulfide, Radioactivity, Discharge ter), Chlorides, Sulfates, Sodium, Calcium, t, Water supply.
ntifiers: *India.

re are over 300 recorded occurrences of ther- and mineral waters in India, with mineral ers limited to about a dozen occurrences only. se waters are associated with different geologi- formations ranging in age from Archean to ternary. The temperature of the springs varies n 28 to 102 degree C. The hotter springs harge carbon dioxide, hydrogen sulfide, and asionally inert gases. Many springs are radioac-, although most of the springs have a low eral content (500-1000 ppm). Trap formations tain saline chloride waters (200-3000 ppm). source of water supply for all the springs is in- ation, with an addition of juvenile or magmatic ponents in the Himalayan region. (Gabriel-GS)
0-06554

ERMAL AND MINERAL WATERS OF TUR- Y (FRENCH),
it Erentoz, and Zati Ternek.
Proceedings of Symposium II on Mineral and rmal Waters of the World, B-Overseas Coun-s, Vol 19, Report of 23rd Session of Interna- al Geological Congress, 1968, Academia que, p 75-84, 1969. 10 p, 2 fig, 1 tab, 4 ref.

criptors: *Thermal water, *Mineral waters, rings, *Aquifers, *Groundwater, Water tem- ature, Water chemistry, Water sources, Water ization, Sulfates, Carbonates, Silicates, dioactivity, Mapping, Discharge (Water). ntifiers. *Turkey.

re are about 529 sources of thermal and eral waters in Turkey with a temperature range 5.0 to 7.90 deg C. The majority of these springs associated with regional fault systems and mic regions, in rocks of different compositions age. Chemical analysis of these thermal and eral springs shows relatively large contents of K, Ca, Mg, Cl, bicarbonate, sulfate, silica, and bon dioxide. The majority of springs are ioactive. The waters of many springs are utilized therapeutic purposes. (Gabriel-USGS)
0-06555

NERAL AND THERMAL WATERS OF NYA,
Walsh.
Proceedings of Symposium II on Mineral and ermal Waters of the World, B-Overseas Coun-s, Vol 19, Report of 23rd Session of Interna- al Geological Congress, 1968, Academia gue, p 105-110, 1969. 6 p, 1 fig, 1 tab, 6 ref

scriptors. *Mineral water, *Thermal water, prings, *Aquifers, *Groundwater, Geology, eous rocks, Lakes, Water chemistry, Water lization, Water temperature, Heat flow, Silica, lfates, Carbonates, Trace elements
ntifiers: *Kenya.

neral and thermal waters are known in many lo- ities in Kenya, mostly within the Great Rift Val- where they are closely connected with the vol- nicity of the area. The majority of the thermal ters are of meteoric origin and considered to be ated by carbon dioxide gas emanating from cool- syenitic magma. Attempts have been made to d large volumes of pressurized steam for the oduction of electric power, and research is still ntinuing. The major exploitation of mineralized ters is at Lake Magadi, where 120,000 metric ns of sodium salts are extracted annually. abriel-USGS)
0-06556

THERMAL AND MINERAL SPRINGS OF MOROCCO (FRENCH),
M. Combe.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 121-137, 1969. 17 p, 3 fig, 3 tab, 5 ref.

Descriptors: *Thermal water, *Mineral waters, *Springs, *Aquifers, Groundwater, Water utilization, Water chemistry, Water temperature, Discharge (Water), Mapping, Geology, Radioactivity, Calcium, Magnesium, Sodium, Carbonates, Silica, Trace elements.
Identifiers: *Morocco.

There are 50 recorded thermal and mineral springs with temperatures ranging from 12 to 50 deg C in Morocco, with 30 springs recognized as possessing some therapeutic characteristic. The spring water reservoirs are in water-bearing horizons consisting of various rock types at depths in the majority of cases not exceeding 500 M. Analysis of spring waters indicates the presence of considerable amounts of Ca, Mg, Na, Cl, sulfate, silica, and free carbon dioxide. (Gabriel-USGS)
W70-06557

THE THERMAL SPRINGS OF MALAWI,
Geological Survey of Malawi, Zomba.
I. M. Kirkpatrick.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 111-120, 1969. 10 p, 1 fig, 1 tab, 11 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Water temperature, Water chemistry, Water sources, Water utilization, Geology, Mapping, Carbonates, Calcium, Sodium, Silica, Magnesium, Sulfates, Trace elements.
Identifiers: *Malawi.

The location and chemical composition of the thermal springs with temperatures ranging from 29 to 78.3 deg C and disseminated through the 23 localities of Malawi are tabulated. Ca, Mg, Na, K, Silica, Cl, carbonate, and sulfate can be considered the main mineral components. The springs are mostly associated with the Rift Valley faults and their mineralized waters are not utilized at present (Gabriel-USGS)
W70-06558

THERMAL AND MINERAL SPRINGS IN UGANDA,
C. G. Dixon, and W. H. Morton.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 191-200, 1969. 10 p, 1 fig, 3 tab, 8 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Geology, Mapping, Water temperature, Water chemistry, Discharge (Water), Water utilization, Structural geology, Salinity, Salts, Carbonates, Calcium, Magnesium, Lakes, Sulfates, Potassium.
Identifiers: *Uganda.

Geohydrological and chemical characteristics of 17 mineral and thermal springs of Uganda are described. Most of the thermal and mineral waters are in or near the Western Rift Valley and are associated with volcanic centers, while 5 are in the eastern part of the country not far from the Eastern Rift Valley of Kenya. The temperature of these waters ranges from 20 to 100 deg C and their chemical analysis shows the presence of Na, K, Ca, Mg, Cl, sulfate, carbonate, borate, carbon dioxide, hydrogen sulfide, and chlorine. The waters are utilized for the production of salt. (Lake Katwe, Lake Kasenyi, and Lake Albert), limestone (Muhoyka, Dura River, and Hima River), and for bathing. (Gabriel-USGS)
W70-06559

MINERAL AND THERMAL WATERS OF RWANDA (FRENCH),
A. Bertossa.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 139-142, 1969. 4 p, 1 fig, 1 tab, 1 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Water temperature, Water chemistry, Water utilization, Mapping, Geology, Permeability, Fissures (Geology), Sodium, Potassium, Silica, Calcium, Magnesium, Carbonates, Sulfates, Trace elements.
Identifiers: *Rwanda.

A brief description of hydrogeological and chemical characteristics of 9 thermal and mineral water occurrences in Rwanda is presented. Some of these waters are characterized by their above-30 deg C temperature, their deep source origin, and their association with the tectonics of Central Africa and regional volcanism. Six other waters are of mineral type and have water temperatures below 25 deg C. The thermal and mineral waters are characterized by the presence of silica, Ca, Mg, Na, K, Cl, bicarbonate, sulfur dioxide, and some trace elements. (Gabriel-USGS)
W70-06560

RECENT REVIEW OF INVESTIGATIONS ON THE THERMAL AND MINERAL SPRINGS IN THE U.A.R.,
Ismail Mahmoud El Ramly.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 201-213, 1969. 13 p, 1 fig, 2 tab, 11 ref.

Descriptors: *Mineral waters, *Thermal water, *Springs, *Aquifers, *Groundwater, Mapping, Geology, Water temperature, Water chemistry, Water utilization, Discharge (Water), Trace elements, Gases, Sodium, Potassium, Calcium, Carbonates, Sulfates.
Identifiers: *U.A.R.

The U.A.R. has about 1,450 flowing springs, mainly associated with carbonate rocks of different geological ages. Some of these springs have a temperature up to 75 deg C and their salinity ranges from a very small amount to the brine state of 35,000 ppm. Detailed chemical analysis of 30 springs shows the presence of considerable amounts of Na, K, Ca, Mg, bicarbonate, sulfate, and Cl. Several springs contain rare elements and gases. In several parts of the country the spring waters are used for irrigation, bathing, and therapeutic purposes. (Gabriel-USGS)
W70-06561

THERMAL AND MINERAL WATERS OF ZAMBIA,
W. H. Reeve.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 215-221, 1969. 7 p, 1 fig, 3 ref

Descriptors: *Thermal waters, *Mineral waters, *Springs, Aquifers, Groundwater, Mapping, Geology, Water chemistry, Water utilization, Water temperature, Discharge (Water), Radioactivity, Salinity, Calcium, Sodium, Potassium, Chlorides, Sulfates, Magnesium.
Identifiers: *Zambia.

There are many springs in Zambia associated with the fractures of the Rift Valley. Analysis of the

waters of 8 springs shows the presence of considerable amounts of K, Na, Ca, Mg, Cl, sulfate, and carbonates. Some radium-bearing springs are located in the region of the confluence of the Kafue and Lunga Rivers. (Gabriel-USGS)
W70-06562

THERMAL AND MINERAL WATERS IN CHILE,
Joaquin Sanchez Rojas.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 257-263, 1969. 7 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Mapping, Geology, Water temperature, Salinity, Discharge (Water), Gases, Sulfates, Calcium, Sulfur.
Identifiers: *Chile.

A simplified map of Chile shows the locations of 44 thermal and mineral waters. A table contains temperature, discharge, and chemical composition data. The temperature of the waters ranges from 20 to 90 deg C and the main mineral constituents are salt, sulfur, carbon dioxide, and sulfur dioxide. Several waters are utilized for bathing and therapeutic purposes. (Gabriel-USGS)
W70-06563

THERMAL AND MINERAL SPRINGS OF JAMAICA,
H. R. Versey.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 265-268, 1969. 4 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Thermal waters, *Mineral waters, *Springs, Aquifers, *Groundwater, Water temperature, Discharge (Water), Water utilization, Water chemistry, Radioactivity, Calcium, Magnesium, Sodium, Potassium, Carbonates, Silica, Sulfates, Mapping.
Identifiers: *Jamaica.

Temperature, discharge, radioactivity, and mineral content of 5 thermal and 3 nonthermal mineral springs of Jamaica are given. Ca, Mg, Na, K, sulfate, bicarbonate, carbon dioxide, silica, and Cl are the chief mineral constituents. The springs of Bath of St. Thomas, Milk River Bath, Rockfort Baths, and Black River Spa are utilized for bathing and therapeutic purposes. (Gabriel-USGS)
W70-06564

THERMAL AND MINERAL WATERS OF TUNISIA (FRENCH),
A. Djellouli.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 181-190, 1969. 10 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Thermal waters, *Mineral water, *Springs, *Aquifers, *Groundwater, Boreholes, Water temperature, Water chemistry, Water utilization, Water sources, Water law, Hydrogeology, Mapping, Geology, Calcium, Magnesium, Sodium, Sulfates, Gases.
Identifiers: *Tunisia.

Temperature, discharge, utilization and chemical composition of the 44 most important thermal and mineral springs of Tunisia are described. The waters, associated with Triassic formations, can be subdivided into the following mineralization types: chlorides; sulfates; bicarbonates; sulfides, and metal-bearing. The temperature of these springs ranges from 20 to 45 deg C in 28 occurrences and from 45 to 75 deg C in 12 occurrences. Many of these springs are utilized for bathing and commercial bottling. (Gabriel-USGS)
W70-06565

MINERAL AND THERMAL WATERS OF CANADA,
J. G. Souther, and E. C. Halstead.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 225-256, 1969. 32 p, 7 fig, 2 tab, 25 ref.

Descriptors: *Mineral waters, *Thermal waters, *Springs, *Aquifers, *Groundwater, Geology, Water temperature, Water chemistry, Water analysis, Water utilization, Discharge (Water), Mapping, Radioactivity, Calcium, Magnesium, Carbonates, Sodium, Potassium, Sulfates, Sulfides, Carbon dioxide.
Identifiers: *Canada.

The distribution and character of mineral and thermal waters in Canada are closely associated with regional topographic and geologic features. All known thermal springs in Canada occur in the Cordilleran region where high relief permits deep circulation of meteoric water. Nonthermal mineral springs are mainly brine springs associated with Paleozic marine sedimentary rocks. Detailed description of 58 thermal and 28 nonthermal mineral springs are given. The mineral content of both thermal and nonthermal springs may be explained by solution aquifer minerals. Ca, K, Mg, Na, bicarbonate, sulfate, Cl, Si, silica, carbon dioxide, and hydrogen sulfide are the chief constituents of these springs. The springs of Canada are utilized for salt production, the sale of bottled mineral water, and for therapeutic purposes. (Gabriel-USGS)
W70-06566

THERMAL AND MINERAL WATERS OF THE UNITED STATES--BRIEF REVIEW OF POSSIBLE ORIGINS,
Geological Survey, Austin, Tex.
Donald E. White.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 269-286, 1969. 18 p, 1 fig, 58 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Reviews, Aquifers, Groundwater, *United States, Surveys, Water types, Water temperature, Water chemistry, Connate water, Meteoric water, Magmatic water, Geology, Geochemistry, Sediments, Brines, Gases, Discharge (Water).
Identifiers: Thermal water classification.

The origin of thermal and mineral waters of the United States is briefly reviewed. The following genetic classes are recognized: meteoric waters characterized by recent contact with the atmosphere; enclosing rocks; partly connate water; partly metamorphic water; juvenile water; and partly volcanic or magmatic water. Chemical composition and hydrogeology of these waters are given. (Gabriel-USGS)
W70-06567

EFFECTIVE USE AND CONSERVATION OF GROUNDWATER,
For primary bibliographic entry see Field 04B.
W70-06570

GEOLOGY AND GROUNDWATER RESOURCES OF THE MORGANTON AREA, NORTH CAROLINA,
Geological Survey, Raleigh, N.C.
Carlton T. Sumsion, and R. L. Laney.
North Carolina Department Water Resources Groundwater Bulletin No 12, March 1967. 119 p, 29 fig, 3 plate, 26 tab, 26 ref.

Descriptors: *Water resources, *North Carolina, *Groundwater, Surface waters, Geology, Hydrogeology, Aquifers, Water wells, Water quality, Hydrologic data, Data collections, Water yi
Water supply, Water levels.
Identifiers: Morganton (NC).

The Morganton area is located in the west-cen
part of North Carolina. Streams and drainage co
ses are of geologically subsequent development
fracture systems which have clearly defined
terns throughout most of the area. Groundwate
obtained from weathered rock or saprolite and
luvium by dug and bored wells. Drilled wells de
groundwater from joint and shear openings in
weathered bedrock. Wells drilled in low, flat a
and narrow, linear valleys have greater yields t
wells drilled on high ground or slopes. The pre
rate of groundwater withdrawal has only local
fect on the height of the water table. The amou
groundwater contained in bedrock decreases
depth, hence drilling wells deeper than about
feet usually will not substantially increase
yields. Generally, groundwater is slightly acid,
tains less than 150 ppm dissolved solids, is soft
than 50 ppm hardness as calcium carbonate),
contains less than 0.3 ppm iron. (Knapp-USGS)
W70-06575

**WATER RESOURCES OF WISCONSIN, RO
FOX RIVER BASIN,**
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-06577

**A STUDY OF THE HYDROLOGY AND GEO
GY OF AREA I OF THE HONOLULU AQUIF**
General Electric Co., Santa Barbara, Calif. Co
for Advanced Studies.
David K. Todd, and Charles F. Meyer.
Prepared for Board of Water Supply City
County of Honolulu. Completion Report 70-T
20, April, 1970. 79 p, 6 tab, 17 fig, 28 ref, 2
pend.

Descriptors: *Aquifer characteristics, *Gro
water recharge, *Saline water-freshwater i
faces, Basalts, Drawdown, Hawaii, Hydrogeo
Mathematical models, Safe yield, Water quality

This study is the first part of a project to deve
mathematical model and to simulate by use
digital computer the dynamic behavior of isoc
when fresh water floats on salt water. Studie
made of the flow of groundwater and its m
with underlying seawater in one part of the h
permeable basalt of the Honolulu aq
Withdrawal at rates exceeding the sustainable
has caused shallow drawdown cones with s
upcoming of brackish water. By the Theis
equilibrium method permeability is estimated
13,700 gpd/sq ft. Recharge into the area, c
lated by three different methods, is found
about 5-1/2 mgd. Leakage of fresh water t
ocean or to adjacent aquifer areas appears
negligible, since withdrawal at approximatel
recharge rate causes no increase in salinity.
also W70-06706).
W70-06705

**A STUDY OF DATA PREPARATION
MATHEMATICAL MODELING OF AREA
THE HONOLULU AQUIFER,**
General Electric Co., Santa Barbara, Calif. C
for Advanced Studies.
David C. Kleinecke, and Charles F. Meyer.
Prepared for Board of Water Supply City
County of Honolulu. Completion Report 70
21, April, 1970. 69 p, 9 fig, 3 append. OWR
ject C-1875 (No 3175) (2).

Descriptors: *Automation, *Data proce
*Saline water-freshwater interfaces, Mathem
models, Hawaii, Hydrologic data.

This study is the second part of a project to de
a mathematical model and to simulate by me
a digital computer the dynamic behavi

hlors when fresh water floats on salt water. iews are made of records of water level, draft, nity, and rainfall for one part of the Honolulu ifer. It is concluded that records are adequate developing a mathematical model of water nity although insufficient to develop a flow lel. Need is noted for more measurements to ne 1000-foot-thick transition zone between h and salt water; for better evaluation of inflow; for water extraction and outflow records out- of research area. Recommendations are made data digitizing procedures and automated cess control. (See also W70-06705)
0-06706

. Water in Soils

QUID-LIMIT DETERMINATION FOR IN-CATING EFFECTIVENESS OF CHEMICALS POND SEALING,
nnessee Univ., Knoxville.
primary bibliographic entry see Field 03B.
'0-06374

IL WATER EVAPORATION, ISOTHERMAL FFUSION, AND HEAT AND WATER ANSFER,
va State Univ., Ames.
D. Fritton, Don Kirkham, and R. H. Shaw.
il Science Society of America Proceedings, Vol , No 2, p 183-189, March-April 1970. 7 p, 6 fig, ref. OWRR Proj No A-003-IA.

scriptors: *Evaporation, *Soil water, *Diffusion, at transfer, Mass transfer, Diffusivity, Water nperature, Winds, Solar radiation, Soil water ovement.
entifiers: Soil water evaporation.

mperature and water distribution data were ken for a 9- by 11- by 20-cm soil column where nd was the evaporation agent and for a similar il column where radiation was the evaporation ent. A Webster silty clay loam soil characterized a soil-water retention curve and an inflow dif- sivity versus water content curve was used in the periments. The experimental results were com- red with results calculated from a solution of the ffusion equation normally used to describe othermal movement of soil water and from a heat d mass transfer solution which accounted for mperature effects. It was found that the isother- al diffusion equation would describe the cumula- ve evaporation for the wind and for the radiation eatments. The isothermal diffusion equation did ot predict the formation of a surface layer of dry il, and thus, did not describe the water distribu- ons for the radiation treatment for times greater an 20 hours or for the wind treatment for times reater than 200 hours. A heat and mass transfer quation did predict the development of a dry sur- ce layer and did describe the water distribution here temperature gradients were important. (K- app-USGS)
/70-06523

EFFECTS OF SALINE WATER ON THE CHEMICAL PROPERTIES OF SOME TROPI-AL SOILS,
Hawaii Univ., Honolulu. Dept. of Agronomy and oil Science.
. A. El-Swaify, and L. D. Swindale.
Soil Science Society of America Proceedings, Vol 4, No 2, p 207-211, March-April 1970. 5 p, 2 fig, tab, 23 ref. OSW Contract No 14-01-001-673.

Descriptors: *Water chemistry, *Soil chemistry, *Saline water, *Soil chemical properties, Acidity, on exchange, Cation exchange, Leaching, Irriga- ion water, Irrigation effects.
Identifiers: Tropical soils, Saline water irrigation.

Surface and subsurface samples of soils represent- ing the Tropical Red Earths and Tropical Red Deserts were equilibrated with unbuffered salt solutions which had the composition of sea water and ranged in concentration between 0.61N and 0.0061N. The original acidities of these soils were highly resistant to change. Neither soil showed a tendency to accumulate salts by extraction from percolating solutions. To eliminate the possible interference by calcium carbonate in observed ionic equilibria, Na-Ca exchange studies were conducted on carbonate-free soils samples. Isoconcentration isotherms were constructed at electrolyte concentrations of 0.01, 0.1, and 1.0N, compared with isotherms calculated from the US Salinity Laboratory's regression equation. Large discrepancies were observed at 1.0N concentration, particularly for the lowest soil horizons. For that concentration, it was found that predictions of ionic distribution based on the theory of the diffuse double layer can closely describe Na-Ca equilibrium when large values of surface charge densities are assumed. (K-napp-USGS)
W70-06524

QUANTITATIVE PREDICTION OF LEACHING IN FIELD SOILS,
North Carolina State Univ., Raleigh. Dept. of Soil Science.
D. L. Terry, and C. B. McCants.
Soil Science Society of America Proceedings, Vol 34, No 2, p 271-276, March-April 1970. 6 p, 4 fig, 4 tab, 16 ref.

Descriptors: *Leaching, *Soil water movement, Soil chemistry, Ion transport, Porosity, Percolation, Fertilizers, Path of pollutants, Ion exchange, Adsorption, Statistical methods.
Identifiers: Soil leaching.

Leaching experiments were conducted under controlled water regime conditions on a variety of soils in the field to study the distribution of certain ions by percolated water. When ammonium, nitrate, and K ions were leached, their movement was generally in the form of a 'normal' distribution. The movement of Mg was not as well defined as the other ions. Multiple regression equations for predicting the leaching of these ions were developed which utilize the parameters of a normal distribution as the dependent variables and properties of the soil and quantities of percolated water as the independent variables. The values for mean movement ranged from 0.92 to 0.97 and those for the standard deviation from 0.56 to 0.91. The principal independent variables were quantity of percolated water, soil porosity as expressed by the weighted porosity index, cation exchange capacity, and the water content at 0.1 bar suction. (Knapp-USGS)
W70-06525

INFRARED ANALYSIS OF PARTIALLY DEUTERATED WATER ADSORBED ON CLAY,
Agricultural Research Service, Watkinsville, Ga. Southern Branch.
Ralph A. Leonard.
Soil Science Society of America Proceedings, Vol 34, No 2, p 339-343, March-April 1970. 5 p, 6 fig, 23 ref.

Descriptors: *Adsorption, *Clay minerals, *Soil water, *Soil structure, *Ion exchange, Spectroscopy, Stable isotopes, Infrared radiation, Hydrogen bonding, Hydration, Montmorillonite, Water structure, Deuterium, Clays, Clay minerals.
Identifiers: Infrared spectoscopy.

Partially deuterated water (HDO) adsorbed on Na, K, Mg, and Ca saturated montmorillonite clays was studied by use of infrared spectroscopy. Positions of the primary O-D absorption band of adsorbed HDO were 2533, 2530, 2506 and 2526/cm, respectively. In addition, a small secondary band was found at 2670/cm. This band may arise from an O-D group very weakly H-bonded to a surface oxygen, or to water isolated in hexagonal cavities in the surface. No evidence of strong H-bonding to the mineral surface was evident. At low water contents, the exchangeable cation exerts the dominant force affecting the structure of the adsorbed water. (Knapp-USGS)
W70-06527

VARIATIONS IN TENSION LYSIMETER LEACHATE VOLUMES,
State Univ. of New York, Syracuse. Dept. of Silviculture.
P. H. Cochran, Giles M. Marion, and Albert L. Leaf.
Soil Science Society of America Proceedings, Vol 34, No 2, p 309-311, March-April 1970. 3 p, 2 fig, 4 tab, 5 ref. NSF Grants GB-1279, GB-2396, and GB-6178.

Descriptors: *Soil water movement, *Lysimeters, *Leaching, Irrigation water, Rainfall, Percolation, Infiltration, Nutrients, Ion transport, Solutes, Instrumentation.
Identifiers: Tension lysimeters.

Leachate volumes collected with tension plate lysimeters placed in a glacial outwash soil and maintained at a fixed tension varied from 1.9-629.9% of the total water applied through rainfall and/or irrigation. The amounts of K passing through plates at depths of 152 cm ranged from 0.02-86.1% of that applied at the surface. These differences were attributed to several factors including nonuniform application of water, large differences in soil moisture retention and flow properties for individual strata, and irregularity of soil strata arrangement at different locations within the study area. Lateral flow to plate surfaces can result in large overestimates of the nutrient flux at a given soil depth. (Knapp-USGS)
W70-06528

WATER REPELLENCY AND INFILTRATION RESISTANCE OF ORGANIC-FILM-COATED SOILS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation. Lab.
For primary bibliographic entry see Field 03B.
W70-06531

2H. Lakes

PRELIMINARY STRATIGRAPHY OF UNCONSOLIDATED SEDIMENTS FROM THE SOUTHWESTERN PART OF LAKE MICHIGAN,
Illinois State Geological Survey, Urbana; and Illinois Univ., Urbana.
For primary bibliographic entry see Field 02J.
W70-06324

MINOR ELEMENT GEOCHEMISTRY OF LAKE MICHIGAN FERROMANGANESE NODULES,
Argonne National Lab., Ill., and Michigan Univ., Ann Arbor.
David N. Edgington, and Edward Callender.
Earth and Planetery Science Letters, Vol 8, No 2, p 97-100, April 1970. 4 p, 1 fig, 1 tab, 15 ref.

Descriptors: *Bottom sediments, *Lake Michigan, *Trace elements, *Geochemistry, *Manganese, Arsenic compounds, Eutrophication, Analytical techniques, Surveys, Dissolved oxygen, Water chemistry, Water quality, Water pollution effects.
Identifiers: Manganese nodules, Green Bay.

Samples of ferromanganese nodules from several localities in Lake Michigan were analyzed for their minor element content by neutron activation techniques. The thorium and uranium levels in Lake Michigan nodules exhibit marked dissimilarities with marine nodules. The radium content of these freshwater nodules is substantially higher than the reported marine values. The concentrations of barium in the Lake Michigan nodules appear to be abnormally high, and patterns obtained using the electron microprobe suggest it is evenly dispersed throughout the nodules. The average arsenic content of these freshwater nodules is at least twice as great as that reported for highly oxidized marine sediments. If all this arsenic is dissolved and released into Green Bay as a result of changing en-

vironmental conditions (eutrophication), the concentration in the water of Green Bay would be several times the maximum permissible level for drinking water. (Knapp-USGS)
W70-06325

THE REDOX POTENTIALS IN SMALL OLIGO AND MEROMICTIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
For primary bibliographic entry see Field 05C.
W70-06327

CURRENTS IN FRENCHMAN BAY AREA OF LAKE ONTARIO,
Ontario Water Resources Commission, Toronto.
M. D. Palmer.
Ontario Water Resources Commission, Great Lakes Survey Program, February 1970 (revised). 39 p, 5 fig, 7 tab, 5 ref, 1 append, addendum.

Descriptors: *Lake Ontario, *Currents (Water), Current meters, Flow, Lakes, Drifting (Aquatic), Water circulation, Topography.
Identifiers: Frenchman Bay (Lake Ontario).

Two recording current meters were operated from June to August, 1968, in 12.7m of water at distances of 2.42m and 4.6m from the bottom approximately 1.6km offshore in the Frenchman Bay area of Lake Ontario. A time series analysis was carried out on the resulting data for the various months. A maximum current of 21 cm/sec. observed was significantly lower than results obtained by similar current meter studies in adjacent areas and farther offshore. This appears to be a result of the shore geometry which reduced the currents in the area. Both the directions and peristence factors agree with results of other studies. Wind does not appear to be directly responsible for currents in the area which are produced as a result of diurnal, inertial and Lake Ontario free oscillation effects. The thermal regimes were a direct consequence of inertial effects. (Knapp-USGS)
W70-06344

THE WATER BUDGET OF A PRAIRIE POTHOLE,
Geological Survey, Denver, Colo.
William S. Eisenlohr, Jr.
In: Quaternary Geology and Climate, Publication 1701, National Academy of Sciences, Wash, DC, p 61-64, 1969. 4 p, 1 tab, 2 ref.

Descriptors: *Hydrologic budget, *Lakes, *Ponds, *Grasslands, Limnology, Evapotranspiration, Evaporation, Rainfall, Seepage, Discharge (Water).
Identifiers: Prairie potholes.

The glaciated prairies of north-central United States contain thousands of shallow topographic depressions, called prairie potholes. These depressions are generally elliptical, less than half a square kilometer in area, and hold water from precipitation and runoff for at least a month, usually without overflowing. The prairie potholes are a part of the habitat along the international flyways of migratory waterfowl. Water budgets of the prairie potholes are representative of a climate that seems to have had no great fluctuations since the recession of the glaciers, because if the climate had been much wetter, drainage channels would be more numerous than they are, and if it had been much drier, the potholes would be filled to a greater extent by aqueous and eolian deposits. The principal items in a water budget for a prairie-pothole pond are precipitation on the pond surface, runoff over frozen or saturated ground or from torrential rainstorms, outflow seepage, and evapotranspiration. The seasonal evapotranspiration is about the same from all ponds. Few potholes overflow and, except in limited areas, there seems to be no groundwater inflow. The outflow-seepage rate is very low, but the overall quantity of water involved is large because of the large number of potholes. (Knapp-USGS)
W70-06353

THEORY OF WATER WAVES GENERATED BY A TIME-DEPENDENT BOUNDARY DISPLACEMENT,
California Univ., Berkeley. Hydraulic Engineering Lab.
Edward Noda.
Available from the Clearinghouse as AD-699 414, $3.00 in paper copy, $0.65 in microfiche. Doctoral thesis, Rept no. HEL-16-5, Oct. 1969, 231 p. 67 fig, 20 ref. Contract DACW72-67-C-0002.

Descriptors: Waves (Ocean), Waves (Water), Landslides, Oceans, Bays, Model studies, Alaska.
Identifiers: Lituya Bay.

The study of water waves generated by landslides in reservoirs and waves generated by submerged landslides in the ocean is carried out by assuming two distinct types of landslides: a vertical landslide modeled by a box falling vertically and a horizontal landslide modeled by a wall moving horizontally. Theoretical solutions to two- and three-dimensional time-dependent boundary-motion problems are obtained using the linear theory of gravity surface waves and the two-dimensional solution is applied to these two models of landslides. Experimental data for the vertical landslide model are compared to the theoretical solution and are found to compare favorably for small values of the box width and velocity. The region of validity of this solution is also determined. A final comparison of this theory to prototype landslides is made for the Lituya Bay, Alaska landslide of 9 July 1958.
W70-06456

SELECTIVE WITHDRAWAL FROM A STABLY STRATIFIED FLUID,
New South Wales Univ., Kensington (Australia). Water Research Lab.
I. R. Wood.
Journal of Fluid Mechanics, vol. 32, part 2, 1968, p. 209-223. 7 fig., 9 ref.

Descriptors: *Stratification, *Reservoirs, *Density stratification.
Identifiers: *Selective withdrawal.

In this paper a reservoir connected through a horizontal contraction to a channel is considered. Both the reservoir and the channel are considered to contain a stable multi-layered system of fluids. The conditions under which there is a flow in only one layer, the depth in this flowing layer decreases continuously from its depth in the reservoir to its depth in the channel, give the maximum discharge that can be obtained with a flow only from this single layer. Where there are velocities in only two layers and the depth in each of these layers decreases continuously from their depths in the reservoir to their depths in the channel, the theory involves computations at two sections in the flow. Experiments have been carried out with a contraction in a flume for the withdrawal of two discrete layers from a three layer system and the withdrawal from a fluid with a linear density gradient. In both cases the reservoir and channel bed and hence the lowest streamline was effectively horizontal. These experiments confirmed the theoretical predictions. (Guerrero-Vanderbilt)
W70-06634

A NOTE ON THE STABILITY OF AN INFINITE FLUID HEATED FROM BELOW,
Imperial Coll. of Science and Technology, London (England). Dept. of Mathematics.
J. L. Robinson.
Journal of Fluid Mechanics, Vol 29, Part 3, p 461-464, 1967. 4 ref.

Descriptors: *Thermal stratification, *Theoretical analysis, Temperature.
Identifiers: *Prandtl number, Temperature profile.

The problem of the stability of a fluid with time-dependent heating has been investigated by Morton (1957), Lick (1965) and Foster (1965). Morton and Lick assumed that the rate of change of the temperature profile is small compared with the growth rate of the disturbances (quasi-static sumption). This assumption is invalid near onset of instability (as defined by (the pa derivative with respect to $t = 0$)), and Foster therefore used an initial-value approach. The ra of validity of the quasi-static assumption discussed, and results of a time-scaled analysis calculations based on this are compared with work of Foster; the agreement is found to be go This study was restricted to a semi-infinite fluid tially at a constant temperature; at time $t=0$ a te perature difference delta T is applied at the (low horizontal boundary (case (A) of Foster). (Gu rero-Vanderbilt)
W70-06638

DISPERSAL OF ALGAE, PROTOZOANS, A FUNGI BY AQUATIC HEMIPTERA, TRICHO TERA, AND OTHER AQUATIC INSECTS,
North Texas State Univ., Denton. Dept. of Biolo
For primary bibliographic entry see Field 05C.
W70-06655

ON THE SIGMOID GROWTH PHASE IN T HISTORY OF LINSLEY POND,
Duke Univ., Durham, N.C. Dept. of Zoology.
D. A. Livingstone.
American Journal of Science, Vol 255, p 364-3 1957. 4 fig, 18 ref.

Descriptors: *History, *Connecticut, *Gro stages, Sedimentation rates, Organic matter, In ganic compounds, Silting, Plankton, Nutrie Phosphorus, Glaciers, Productivity, Dep Phosphates, Ecosystems, Pollen, Biomass, M Zooplankton, Phytoplankton, Adsorption, exchange, Diatoms, Oligotrophy, Eutrophicati Paleolimnology, Stratigraphy.
Identifiers: *Linsley Pond (Conn), Bosmi Microfossils, Biocoenosis, Gyttja.

The principal change in the stratigraphy of Lo Linsley Pond is a sigmoid increase in organic microfossil sediment content. This investigat shows that the sigmoid increase is associated w extra-lacustrine changes and may have resul from world-wide postglacial warming. New calcu tions are presented involving previously publish data. Using the brown bands of Vallentyne Swabey as a time scale, Bosmins counts and ganic-inorganic measurements of Deevey ha been translated into terms of sedimentation/squ centimeter per year. Recalculated results show t the apparent logarithmic increase in Bosm production early in the lake's history is valid, that the logarithmic increase in organic matte largely an artifact due to previous methods of culation. The most significant change during period was a decrease in the rate of inorganic se mentation. It is suggested that silting controlled production of Bosmina and other plankton org isms in the lake's early history and again in rec years, by interfering with the regeneration nutrients in the diagenetic layer. This is suppor by the correspondence between the ratio phosphorus to total organic matter, calcula from the data of Hutchinson and Wollack, and ash content of the sediment. (Jones-Wisconsin)
W70-06659

TWO METHODS OF DESCRIBING T 'AVERAGE' VERTICAL TEMPERATURE D TRIBUTION OF A LAKE,
Department of Energy, Mines and Resources, tawa (Ontario). Marine Sciences Branch.
H. E. Sweers.
Journal Fisheries Research Board of Canada, 25, No 9, p 1911-1922, 1968. 3 fig, 3 ref.

Descriptors: *Lakes, *Water temperatu Methodology, Isotherms, Thermocline, Lake tario, Stratification.
Identifiers: *Vertical temperature distributi Temperature gradients, Sinusoidal internal wav Temperature profiles.

rage vertical pattern of temperature in a fresh-
r, stratified lake can be obtained by computa-
of the average temperature at different levels
by computation of the average depth of a
ber of isotherms. The latter technique
nises a more realistic approximation of tem-
ture profiles, especially in the thermocline re-
. (Wilde-Wisconsin)
)-06665

IDIES ON ASTERIONELLA FORMOSA SS. II. NUTRIENT DEPLETION AND THE RING MAXIMUM, PARTS I AND II,
shwater Biological Association, Ambleside (En-
d).
. G. Lund.
rnal of Ecology, Vol 38, No 1, p 1-35, 1950. 5
6 tab, 81 ref.

criptors: *Nutrients, *Spring, Diatoms, Silica,
rates, Phosphates, Fungi, Parasitism, Calcium,
npling, Seasonal, Cycles, Sewage, Cyanophyta,
rophication, Silts, Chlorophyceae, Depth,
ods, Light intensity, Temperature, Grazing,
orella, Nitzschia, Silicates, Carbon, Hydrogen
concentration, Alkalinity, Iron, Manganese,
ara.
ntifiers: *Spring maximum, *Asterionella for-
sa Hass, *Windermere (England), *Esthwaite
ter (England), *Blelham Tarn (England),
gellates, Sphaerocystis, Schroeteri, Desmids,
gilaria crotonensis, Tabellaria fenestrata,
izophidium planktonicum, Cyclotella, Oscilla-
ia, Coelenterates, Lamellibranchs, Zooxanthel-
, Dinobryon, Stephanodiscus.

servations were made during five years, from
nter to summer, on numerical fluctuation of
terionella formosa and other diatoms, and on
rying concentrations of dissolved silica, nitrates
d phosphates in three English lakes. The close of
e spring Asterionella increase is not directly af-
cted by light or temperature, but is frequently
e to depletion of silica. Grazing by animals had
appreciable effect on numerical variation. Fun-
l parasitism may affect the course of the spring
crease, but rarely causes its termination. Diatoms
nnot multiply appreciably when the silica con-
ntration is less than 0.5 milligrams per liter, but
ailability of silica does not provide a complete
planation of fluctuations in diatom numbers. The
ean silica content of Asterionella formosa cells is
0 micrograms per million. The amount of silica
r unit area of cell is constant under all condi-
ons. The nitrogen content in natural and cultural
opulations varied from 6 to 12 micrograms/mil-
on cells. Phosphorus content varied widely;
sterionella cells can store phosphorus in excess of
mediate requirements, concentration in the
ater being 1 microgram per liter or less.
sterionella can utilize calcium at a concentration
400 micrograms per liter. (Jones-Wisconsin)
70-06670

UPPLEMENTAL REAERATION OF LAKES ND RESERVOIRS,
anderbilt Univ., Nashville, Tenn. Dept. of Sanita-
and Water Resources Engineering; and New
lexico State Univ., University Park. Dept. of Sani-
ary Engineering.
dward L. Thackston, and R. E. Speece.
ournal American Water Works Association, Vol
8, p 1317-1324, 1966. 1 fig, 23 ref.

Descriptors: *Aeration, *Water circulation, Reservoirs, Oxygenation, Oxygen sag, Bubbles, Lakes, Stratification, Dissolved oxygen, St Lawrence Seaway, Application methods.
Identifiers: *Reaeration methods, Supplemental reaeration, Ossining Reservoir (N Y), Lake Wohlford (Calif), Folsom Dam (Calif), Oconto River (Wis), European lakes.

Methods of supplemental aeration, or rather mixing stratified water to bring the stagnant hypolimnion in contact with atmospheric oxygen, are reviewed. The first attempts to mix a stratified body of water by a centrifugal pump were replaced by the use of compressed air introduced into the hypolimnion through a perforated hose. Promising results were obtained with aerohydraulic guns shooting air bubbles to the surface from submerged tubes. Drainage of a reservoir to a lower location, submerged weirs, monitoring dissolved oxygen, selective withdrawal of water, passing river water through spray nozzles, and Bunger valves are among other methods of correcting the dissolved oxygen deficit. Stirring surface of water, even when accomplished by paddle-wheel steamers, had little effect. (Wilde-Wisconsin)
W70-06672

PHOTOPERIOD CONTROL OF DIAPAUSE IN DAPHNIA. II. INDUCTION OF WINTER DIAPAUSE IN THE ARCTIC,
Arctic Inst. of North America, Washington, D.C.
Raymond G. Stross.
Available from the Clearinghouse as AD-699 018, $3.00 in paper copy, $0.65 in microfiche. Prepared in cooperation with State Univ. of New York, Albany, Department of Biology. Published in The Biological Bulletin, V. 136, No. 2, p. 264-273, Apr 69. Contract Nonr-3996 (01).

Descriptors: *Crustaceans, Reproduction, *Daphnia, *Photoperiodism, Climatology, Aquatic microorganisms, Food chanis, *Arctic.
Identifiers: *Daphnia middendorffiana, Barrow, Alaska.

Control of the sexual polymorphism leading to an embryonic diapause was studied in an arctic population of Daphnia middendorffiana. The reproductive cycle is similar to a previously analyzed population of D, pulex although males are non-functional in the polymorphism. Results of this study support the previous hypothesis in part, namely, that the sexual polymorphism in short-day induced populations of Daphnia may be under the control of photoperiod. Also shown is the latitudinal adjustment necessary for functioning of photoperiod at mid and high latitudes.
W70-06709

2I. Water in Plants

SWAMP VEGETATION-AN INDICATOR FOR NON-FROZEN AREAS IN THE NORTHERN TAIGA OF WESTERN SIBERIA,
For primary bibliographic entry see Field 02C.
W70-06396

2J. Erosion and Sedimentation

PRELIMINARY STRATIGRAPHY OF UNCONSOLIDATED SEDIMENTS FROM THE SOUTHWESTERN PART OF LAKE MICHIGAN,
Illinois State Geological Survey, Urbana; and Illinois Univ., Urbana.
D. L. Gross, J. A. Lineback, W. A. White, N. J. Ayer, and Charles Collinson.
Illinois State Geological Survey Environmental Geology Note No 30, February 1970. 20 p, 6 fig, 2 plate, 11 ref.

Descriptors: *Bottom sediments, *Lake Michigan, Mineralogy, Water chemistry, Clay minerals, Glacial drift, Sampling, Dating.
Identifiers: Lake Michigan sediments.

Sampling of the unconsolidated sediments of southern Lake Michigan was begun in the summer of 1969. The geology and the chemistry of these sediments was studied with emphasis on their pollution, as measured by lead and other inorganic constituents. The sediment sequence includes, from the top, a few centimeters of sandy silty clay on the lake floor; 0.5 to 1.0 meter of dark gray silty clay alternating with thin black clay layers; 0.5 meter of brownish gray silty clay containing thin dark layers; 0.75 meter of orangish brown clay in which there is a traceable gray clay bed 0.15 meter thick; and a homogeneous, pink clay more than 1.0 meter thick that overlies glacial outwash and till. The black layers in the upper part of the cores have yielded a radiocarbon date of 6920 plus or minus 200 years B.P. Within the lacustrine sediments, grain size decreases with depth. Water content ranges from 100% to more than 200% of dry weight. Illite, chlorite, kaolinite, and expandable clay minerals are mixed throughout the cores, although expandables decrease downward and kaolinite decreases upward. (Knapp-USGS)
W70-06324

MINOR ELEMENT GEOCHEMISTRY OF LAKE MICHIGAN FERROMANGANESE NODULES,
Argonne National Lab., Ill., and Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 02H.
W70-06325

SEDIMENTATION IN PLUM CREEK SUBWATERSHED NO. 4, SHELBY COUNTY, NORTH-CENTRAL KENTUCKY,
Geological Survey, Washington, D.C.
Peter W. Anttila.
Report available for sale by Superintendent of Documents, U S Government Printing Office, Washington, D C 20402. Geological Survey Water-Supply Paper 1798-G, p GI-G54, 1970. 54 p, 17 fig, 1 plate, 8 tab, 10 ref.

Descriptors: *Reservoir silting, *Sedimentation, *Kentucky, Sediment load, Reservoirs, Sediment yield, Sediment control, Small watersheds, Deposition (Sediments), Reservoir design.
Identifiers: Plum Creek (Ky).

The sedimentation investigation of Plum Creek subwatershed No. 4 above Tucker Dam, Kentucky was part of a cooperative nationwide investigation of trap efficiency. Runoff from 28 percent of the 1.55-square-mile drainage area passes through several livestock-watering ponds formed by earthfill dams before reaching reservoir No. 4. The principal source areas eroded are thought to be barnyards, plowed fields (10 percent of the subwatershed), grazing land and cropland in SCS land capability class VI, and land cultivated in Lowell soils. The sediment yield from the 1.55 square miles was estimated to be 4.03 tons per square mile per year for the period between March 20, 1957, and April 2, 1959, and 5.44 tons per square mile per year between April 2, 1959, and May 20, 1964. Storm runoff accounted for 93 percent of the 1,860 tons of sediment per year discharged from reservoir No. 4 and this runoff occured in 6 percent of the period of investigation, April 1, 1956, to September 30, 1964. All the sand (generally less than 5 percent of the total suspended sediment) and a substantial amount of the silt and clay entering the reservoir are trapped. If sediment deposition continues at the average rate that was measured during the investigation, 2.15 acre-feet per year, the useful life of reservoir No. 4 will be 46 years. The trap efficiency, computed from measured weight of sediment outflow and estimated weight of sediment deposition, averaged 92 percent. (Knapp-USGS)
W70-06334

SUSPENDED-SEDIMENT LOAD OF TEXAS STREAMS, COMPILATION REPORT OCTOBER 1963--SEPTEMBER 1965,
Texas Water Development Board, Austin.
H. M. Cook.
Texas Water Development Board Report 106, January 1970. 62 p, 1 fig.

Descriptors: *Suspended load, *Texas, Streams, Streamflow, Data collections, Hydrologic data, Sedimentation, Sediment load, Sediment discharge.
Identifiers: Suspended sediment load (Tex).

Suspended sediment load data for Texas streams, 1963-65, are tabulated. During the period covered

by this report, the Texas Water Commission operated 36 suspended-sediment sampling stations. Data resulting from sediment investigations for 13 stations operated by the International Boundary and Water Commission, United States and Mexico and three stations operated by the United States Geological Survey are included. Samples are collected in 8-ounce narrow-neck bottles at a position approximately 1 foot below the water surface near midstream. The percentage of suspended sediment by weight obtained from the sample is multiplied by the factor 1.102 to obtain the mean percentage of suspended sediment in the vertical profile. Laboratory determinations were equated to the corresponding streamflow in determining the total suspended-sediment load. (Knapp-USGS)
W70-06342

DETERMINATION OF THE MANNING COEFFICIENT FROM MEASURED BED ROUGHNESS IN NATURAL CHANNELS,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02E.
W70-06352

STUDY ON THE LONGITUDINAL PROFILE OF RIVER BED (JAPANESE),
Public Works Research Inst., Tokyo (Japan).
Akihiko Tsuchiya, and Katsuyoshi Ishizaki.
Report on Public Works Research Institute, Tokyo, Japan, Vol 136, p 1-12, March 1969. 12 p, 15 fig, 82 ref.

Descriptors: *Channel morphology, *Rivers, *Sediment transport, Sedimentation, Stream erosion, Channel improvement, Scour, Profiles.
Identifiers: Joganji River (Japan).

The two fundamental concepts of equilibrium theory of river bed profile and successive calculation of river bed fluctuation were examined and applied to improvement projects in stable river channels. The existing longitudinal bed profile could not be explained well by the equilibrium theory. Lack of equilibrium in the existing river was shown by the changing river-bed profile. A fundamental equation which expresses river bed variation was determined and applied to the Joganji River. The calculated results showed that the mechanism of river bed variation was well explained by the equation. A design criteria of stable river channels was based on the fundamental concept of river bed variation. (Knapp-USGS)
W70-06356

A SYSTEM FOR MEASURING AND SAMPLING RUNOFF CONTAINING SEDIMENT AND AGRICULTURAL CHEMICALS FROM NEARLY LEVEL LANDS,
Agricultural Research Service, Baton Rouge, La.
G. H. Willis, J. M. Laflen, and C. E. Carter.
Trans Amer Soc Agr Eng, Vol 12, No 5, p 584-587, Sept-Oct 1969. 4 p, 1 fig, 4 tab, 7 ref.

Descriptors: *Sediments, Chemicals, Water resources, Agriculture, Head loss, *Runoff, Samplers, Rainfall, Watersheds (Basins), Parshall flumes, Weirs, Volume, Analysis, Endrin, Chromatography, Clays, Water pollution, Silts, Pollutants, Models, *Agricultural chemicals, Measurement, *Water pollution sources, Pesticides, Nitrates, Water analysis.
Identifiers: Coshocton sampler.

Controversies over suggestions that agricultural chemicals might be polluting water resources of this nation make it imperative that the quality of runoff from agricultural lands be characterized accurately. To do this, special care must be exercised to collect samples that truly represent the runoff. A Parshall flume, Geib multislot divisor, sump pump, and storage tanks, appropriately arranged, provided a system that measured runoff with reasonable accuracy and collected representative samples of the runoff. Very little head loss through the system was experienced. The vertical distance from the flume entrance to the divisor outlet was 4.5 in. Little difference was apparent in silt, clay, nitrates, or endrin contents in overall comparisons between slot and channel samples for all flow rates and sediment concentrations tested. All endrin entering the system was recovered proportionately in the sample. (USBR)
W70-06369

DEPOSITION AND SCOUR DOWNSTREAM FROM SEMIPERMEABLE STRUCTURES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulic and Water Power.
For primary bibliographic entry see Field 08A.
W70-06385

A STATISTICAL STUDY OF SAND WAVES,
Kayoto Univ. (Japan). Disasters Prevention Research Inst.
K. Ashida.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B12, p 103-110, 1967. 8 p, 10 fig, 3 tab, 5 ref.

Descriptors: *Sand waves, *Dunes, *Roughness (Hydraulic), Statistical methods, Markov processes, Stochastic processes, Time series analysis, Bed load, Regime, Sounding.
Identifiers: Spectral analysis.

Statistical characteristics of sand waves should be useful for describing the bed roughness quantitatively. Analog and digital records of bed elevation are obtained as a function of both distance and time by a supersonic sounder for various regime of bed forms: namely, ripples, dunes, transition and standing waves. The characteristics of autocorrelation and spectral density function are discussed with relation to the bed regimes. The process of bed elevations for both dunes and standing waves is approximately represented by a Markov second-order linear process but the process for both ripples and transition should be represented by higher order Markov process. The authors also discuss the relation between two spectral density functions concerning distance and time. Moreover, the authors discuss the distribution of the wave heights and lengths. (Knapp-USGS)
W70-06395

THE BIRTH AND DEVELOPMENT OF THE CONCEPT OF DIAGENESIS,
Strasbourg Univ. (France). Inst. of Geology.
For primary bibliographic entry see Field 10.
W70-06398

HILLSLOPE SEDIMENTATION AND SOIL FORMATION IN NORTHEASTERN IOWA,
Iowa State Univ., Ames.
Harold J. Kleiss.
Soil Science Society of America Proceedings, Vol 34, No 2, p 287-290, March-April 1970. 4 p, 4 fig, 5 ref.

Descriptors: *Sedimentation, *Particle size, *Alluvium, *Soil formation, *Slopes, Soil profiles, Soils, Sands, Glacial drift, Deposition (Sediments), Ion exchange, Organic matter.
Identifiers: Sorting (Sediments).

Systematic investigation of a hillslope from summit to alluvial positions revealed that particle size variations within the soil A horizons are due to sedimentological sorting. The mean particle size in the surficial sediments follows a systematic decrease within two subset systems down the hillslope. Each subset is expressible mathematically. A discordance in the backslope position is caused by truncation of a sand zone within the till underlying the surficial material. Hillslope sedimentation has also influenced accumulation of organic matter, bulk density, and cation exchange capacities in the soils formed at various positions on the sl
Profile characteristics indicate little pedog
development; rather, many of the soil proper
are inherited from the sedimentary nature of
hillslope surficial sediment. (Kanpp-USGS)
W70-06526

COMMUNITY ACTION GUIDEBOOK F SOIL EROSION AND SEDIMENT CONTROL
National Association of Counties Research Fo
dation, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-06574

2K. Chemical Processes

MINOR ELEMENT GEOCHEMISTRY OF LA MICHIGAN FERROMANGANESE NODULES
Argonne National Lab., Ill., and Michigan Un
Ann Arbor.
For primary bibliographic entry see Field 02H.
W70-06325

THE REDOX POTENTIALS IN SMALL OLI AND MEROMICTIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
For primary bibliographic entry see Field 05C.
W70-06327

FURTHER STUDIES OF PROPERTIES OF S WATER AND ITS CONCENTRATES TO DEG C,
California Univ., Berkeley.
For primary bibliographic entry see Field 03A.
W70-06331

RECONNAISSANCE OF WATER TEMPE TURE OF SELECTED STREAMS SOUTHEASTERN TEXAS,
Geological Survey, Austin, Tex.
Jack Rawson.
Texas Water Development Board Report
January 1970. 13 p, 4 fig, 2 tab, 5 ref.

Descriptors: *Water temperature, *Streams, *T
as, Surveys, Data collections, Hydrologic d
Water quality.
Identifiers: Stream water temperature (Tex).

Temperature-profile measurements were mad
61 cross sections of 7 major streams in Texas.
cross-sectional variations of temperature were
served during 147 measurements. Only 34 m
surements showed a temperature difference
more than 0.5 deg C within a cross section;
maximum difference encountered was 1.5 deg
Therefore, point-temperature records reported
the U.S. Geological Survey in Texas are usu
representative of the average temperature of w
within the stream cross section. Air temperatur
a reasonable index of the temperature of the m
streams in the State--provided that temperatur
not affected by such artificial influences as addi
of treated wastes or presence of impoundments
8 sites where artificial influence was not signific
the mean monthly water temperatures, as c
puted from once-daily observations, seldom
fered from corresponding mean monthly air t
peratures by more than 2 deg C and often diffe
by no more than 1 deg C. The temperatures
Texas streams vary widely from month to mo
The spread between observed monthly maxim
and minimum temperatures averages 3-6 deg
(Knapp-USGS)
W70-06343

PRELIMINARY RESULTS FROM STATIS CAL ANALYSIS OF WATER QUALITY SELECTED STREAMS OF NEBRASKA,
Geological Survey, Lincoln, Nebr.
For primary bibliographic entry see Field 05A.
W70-06349

RIATIONS IN THE CHEMICAL QUALITY GROUNDWATER BENEATH AN IR-ATED FIELD, CEDAR BLUFF IRRIGATION TRICT, KANSAS,
ological Survey, Lawrence, Kans.
ert B. Leonard.
sas Department of Health Environmental lth Services Bulletin 1-11, 1969. 20 p, 11 fig, 1 3 ref.

scriptors: *Water quality, *Groundwater, *Ir-tion water, *Leaching, *Kansas, Recharge, In-ation, Solutes, Aqueous solutions, Water mistry, Mineralogy, Soil water, Groundwater vement, Hydrogeology.
ntifiers: Cedar Bluff (Kans).

e concentrations of the major ions in the waters m closely spaced observation wells in a cul-ated field in the Cedar Bluff Irrigation District, nsas varied widely from well to well. Percolation irrigation water into the aquifer and lateral dis-cement of the original groundwater progressive-changed the ionic composition of most of the ters during the first 3 years of irrigation. The erage concentration of chloride in the ground-ter underlying the field decreased from about 0 to 130 mg/liter and the outflow exceeded in-w of chloride for the period November 1965 to tober 1967. Although the concentration of lfate also decreased slightly during the same riod, the quantity of sulfate in storage remained arly constant. If the observed changes are presentative of changes occurring elsewhere in e district, they substantiate the conclusion that ogressively increasing contributions of ground-ater runoff from the irrigation district raised the ncentration of chloride in low streamflow of the noky Hill River adjacent to the district. (Knapp-SGS)
70-06358

PPLICATION OF COMPUTER TECHNIQUES O SEEPAGE-SALINITY SURVEYS IN KAN-AS,
eological Survey, Lawrence, Kans.
or primary bibliographic entry see Field 07C.
70-06508

UANTITY AND QUALITY OF LOW FLOW IN HE PECOS RIVER BELOW GIRVIN, TEXAS, EBRUARY 6-9, 1968,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-06511

TRITIUM CONCENTRATION IN PRECIPITA-TION, 1967-1968,
Southwestern Radiological Health Lab., Las Vegas, Nev.; and Southeastern Radiological Health Lab., Montgomery, Ala.
For primary bibliographic entry see Field 05B.
W70-06515

EFFECTS OF SALINE WATER ON THE CHEMICAL PROPERTIES OF SOME TROPI-CAL SOILS,
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.
For primary bibliographic entry see Field 02G.
W70-06524

QUANTITATIVE PREDICTION OF LEACHING IN FIELD SOILS,
North Carolina State Univ., Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W70-06525

INFRARED ANALYSIS OF PARTIALLY DEU-TERATED WATER ADSORBED ON CLAY,
Agricultural Research Service, Watkinsville, Ga. Southern Branch.
For primary bibliographic entry see Field 02G.
W70-06527

THE STRUCTURE OF WATER,
Ambassador Coll., Pasadena, Calif. Dept. of Chemistry.
For primary bibliographic entry see Field 01A.
W70-06537

THERMAL SPRINGS OF THAILAND,
For primary bibliographic entry see Field 02F.
W70-06551

THERMAL AND MINERAL SPRINGS OF SOUTH VIETNAM (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06552

MINERAL AND THERMAL WATERS OF JAPAN,
For primary bibliographic entry see Field 02F.
W70-06553

MINERAL AND THERMAL WATERS OF INDIA,
For primary bibliographic entry see Field 02F.
W70-06554

THERMAL AND MINERAL WATERS OF TURKEY (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06555

MINERAL AND THERMAL WATERS OF KENYA,
For primary bibliographic entry see Field 02F.
W70-06556

THERMAL AND MINERAL SPRINGS OF MOROCCO (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06557

THE THERMAL SPRINGS OF MALAWI,
Geological Survey of Malawi, Zomba.
For primary bibliographic entry see Field 02F.
W70-06558

THERMAL AND MINERAL SPRINGS IN UGANDA,
For primary bibliographic entry see Field 02F.
W70-06559

MINERAL AND THERMAL WATERS OF RWANDA (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06560

RECENT REVIEW OF INVESTIGATIONS ON THE THERMAL AND MINERAL SPRINGS IN THE U.A.R.,
For primary bibliographic entry see Field 02F.
W70-06561

THERMAL AND MINERAL WATERS OF ZAMBIA,
For primary bibliographic entry see Field 02F.
W70-06562

THERMAL AND MINERAL WATERS IN CHILE,
For primary bibliographic entry see Field 02F.
W70-06563

THERMAL AND MINERAL SPRINGS OF JAMAICA,
For primary bibliographic entry see Field 02F.
W70-06564

THERMAL AND MINERAL WATERS OF TUNISIA (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06565

MINERAL AND THERMAL WATERS OF CANADA,
For primary bibliographic entry see Field 02F.
W70-06566

THERMAL AND MINERAL WATERS OF THE UNITED STATES--BRIEF REVIEW OF POSSIBLE ORIGINS,
Geological Survey,.Austin, Tex.
For primary bibliographic entry see Field 02F.
W70-06567

CYCLING OF CHLORINE THROUGH A FORESTED WATERSHED IN NEW ENGLAND,
Dartmouth Coll., Hanover, N.H. Dept. of Earth Sciences.
Franz H. T. Juang, and Noye M. Johnson.
Journal of Geophysical Research, Vol 72, No 22, p 5641-5647, November 15, 1967. 7 p, 3 tab, 21 ref. NSF Grants GB4169 and GB1144.

Descriptors: *Chlorides, *Small watersheds, *Water chemistry, Leaching, Rainfall, Runoff, Infiltration, Seepage, Groundwater movement, Soil-water-plant relationships, Geochemistry, Hydrologic budget, Hydrologic cycle, Hydrogeology.
Identifiers: Chloride cycle, Chloride budget.

The annual chloride budget of two small forested watersheds in New Hampshire has been measured for the period September 1965 through August 1966. Chemical sampling was done on a weekly basis. Average yearly chloride concentration in precipitation and run-off water was 0.2 and 0.5 mg/liter, respectively. Using a network of rain gage and stream flow data, the total amount of chloride entering and leaving the system was calculated. It was found that 410 kg/sq km of chloride annually moves through the watersheds. During the study period two-thirds of the chloride input into the system was from wet removal of atmospheric chloride; the remaining one-third was attributed to dry removal by an impaction and/or adsorption process on the forest canopy. Chemical weathering and direct cultural activities do not contribute measurably to the chloride budget of the study area. (Knapp-USGS)
W70-06571

CHLOROPHYLLS,
Chicago Univ., Ill. Dept. of Botany.
L. Bogorad.
Physiology and Biochemistry of Algae, R A Lewin, editor, Academic Press, New York, 1962. p 385-408. 2 fig, 2 tab, 89 ref.

Descriptors: *Chlorophylls, Metabolism Algae, Chlorella, Euglena, Distribution, Properties, Chlorophyta, Euglenophyta, Chrysophyta, Phaeophyta, Pyrrophyta, Cyanophyta, Rhodophyta, Absorption, Nutrients, Light intensity, Temperature, Age, Scenedesmus, Chlamydomonas, Cyanidium, Anacystis.
Identifiers: Biosynthesis, Biliproteins, Carotenes, Xanthophylls, Xanthophyta, Bacillariophyta, Cryptophyta, Pheophytin, Chlorella, Euglena gracilis, Scenedesmus obliquus, Porphyridium, Synechococcus, Navicula, Cryptomonas, Gonyaulax, Nostoc.

This is a digest of literature concerning properties and distribution of chlorophyll, including the history of biosynthesis of chlorophyll. Use of algae for chlorophyll metabolism investigations was motivated by interst in algae and by their facility in experimentation; Chlorella and Euglena were studied primarily. From spectral data, functional chlorophylls in vivo are not in the same molecular state as chlorophylls dissolved in organic solvents, but nature of these differences remains unresolved.

Studies on algae cultured under controlled laboratory conditions reveal that mineral nutrition, light intensity, and cell age can be major factors in influencing the concentrations of chlorophyll in an individual organism. Relation of chlorophyll content, cell number, and cell size to light intensity is discussed. Experiments with the crossed-gradient plate also demonstrated that the chlorophyll content of various algae can change rapidly as cells age and the culture medium becomes depleted of mineral nutrients; the green zone generally moves from lower to higher temperatures within the same light-intensity range. Streptomycin, heat, chlortetracycline, acriflavine, and pyribenzamine have been reported to induce development of strains lacking chlorophyll. (Jones-Wisconsin)
W70-06661

2L. Estuaries

INFLUENCE OF TIDAL INLETS ON SALINITY AND RELATED PHENOMENA IN ESTUARIES,
Texas Univ., Austin. Hydraulic Engineering Lab.
Frank D. Masch.
Available from the Clearinghouse as PB-191 707, $3.00 in paper copy, $0.65 in microfiche. Technical Report HYD 16-7001, CRWR 49, March, 1970. 107p, 6 tab, 30 fig, 21 ref. OWRR Project B-023-TEX (1).

Descriptors: *Estuaries, *Bays, *Tidal inlets, *Tidal hydrodynamics, *Salinity distributions, Mathematical models, Convective dispersion.
Identifiers: Pass openings, Gulf coast, Physical exchange.

This study presents mathematical hydrodynamic and salinity transport models applicable to the analysis of the effects of tidal inlets on bays and estuaries having the typical morphology encountered in the U.S. coastal regions on the Gulf of Mexico. The practical utility of these models has been developed and demonstrated for the following specific cases. (1) Simulation of tidal hydrodynamics and salinity distributions under well-mixed water conditions for two bays on the Texas Gulf coast. (2) Analysis of the effects of altering natural tidal inlets on estuary-Gulf exchange and on salinity concentration, transport and distribution. Analyses were conducted on both idealized and real estuaries; (3) Simulation and analysis of hypothetical shell reef removal. Specifically, Matagorda Bay, Texas, was used to verify both the tidal hydrodynamic model and salinity distribution model. Galveston Bay, Texas, was used to demonstrate the effects of altering the size of the tidal inlet on water interchange and salinity distribution. Using computed 'baseline' conditions for low and intermediate freshwater inflows to Galveston Bay, the assumption was made that an improved, continuously open tidal inlet was created at Rollover Pass into the Galveston Bay system. Changes in salinities, salinity gradients, Gulf inflows, tidal prisms, and circulation were computed for intermediate and low fresh water inflows. (Runkles-Texas A and M University)
W70-06315

A STUDY SUBMERGED DREDGE HOLES IN NEW JERSEY ESTUARIES WITH RESPECT TO THEIR FITNESS AS FINFISH HABITAT.
New Jersey Dept. of Conservation and Economic Development. Nacote Creek Research Station.
Walter S. Murawski.
New Jersey Division of Fish and Game Miscellaneous Report No 2-M, October 1969. 32 p, 6 tab, 6 chart, 3 ref, 2 append. Fish and Wildlife Service Project F-15-R.

Descriptors: *Aquatic habitats, *Fish conservation, *Stream fisheries, *Estuarine fisheries, *Dredging, Dissolved oxygen, Water quality, Aquatic environment, Estuarine environment, Limnology.
Identifiers: Dredge holes.

Thirty-eight submerged dredge holes in New Jersey estuaries were examined with respect to their fitness as finfish habitat. Water quality parameters examined were temperature, salinity, dissolved oxygen concentration and hydrogen sulfide concentration. Of the 38 holes, 21 had dissolved oxygen and/or hydrogen sulfide conditions that could not sustain healthy fish life. Of the 33 holes examined for invertebrate fauna, 20 lacked any bottom invertebrates. The highest amounts of organic matter and the highest concentrations of soluble ferrous and manganese ions in the bottom muds were associated with stagnant holes. The reasons for the stagnation of these holes are: too great a depth in relation to the surrounding water, intrusion of poor quality groundwater, abnormally high accumulation of detritus, and prevention of mixing. Although the formation of stagnant or semistagnant holes is not recommended, some were of benefit in that they retained warm water in fall and winter, thus concentrating the fish at mid-depths, which is of value to the angler. (Knapp-USGS)
W70-06362

FRESH WATER WHITECAPS,
Hobart and William Smith Colleges, Geneva, N.Y.
Edward C. Monahan.
Available from the Clearinghouse as AD-698 977, $3.00 in paper copy, $0.65 in microfiche. Jnl of Atmospheric Sciences, V. 26, No. 5, Pt. 2, p. 1026-1029, Sept. 69. ONR Contract N00014-68-C-0409, NR 083-212.

Descriptors: *Waves, Lake morphometry, Lakes, Great Lakes, Winds, Velocity, Air temperature, Thermal properties, Hygrometry, Anemometers, Bubbles.
Identifiers: *Whitecaps, Lake Superior, Lake Huron, Lake Erie, Detroit Edison vessel, Naugatuck vessel, Air water interactions, Wind velocity.

Photographic observations of the whitecap coverage of large fresh water lakes were made in conjunction with measurements of wind velocity, and air and surface water temperatures. The fraction of the water surface covered by whitecaps shows an abrupt increase as the wind velocity increases from approximately 7 to approximately 8 m/sec. This abrupt change is qualitatively in accord with the published observations of 'critical' wind velocities associated with numerous other water-surface and surface-related phenomena. The whitecap coverage of fresh water bodies, particularly at the higher wind velocities, is much less than the published values of whitecap coverage of oceans under the same wind conditions.
W70-06459

DISTRIBUTION OF BENTIC FAUNA IN THE WESTERN BERING SEA BY TROPHIC ZONES AND SOME GENERAL PROBLENS OF TROPHIC ZONATION,
Naval Oceanographic Office, Washington, D.C.
A. P. Kuznetsov.
Available from the Clearinghouse as AD-699 862, $3.00 in paper copy, $0.65 in microfiche. U.S. Naval Oceanographic Office, Rept. No. NOO-Trans-460, Translation Wash D.C., 1969. Akademiya Nauk SSSR. Institut Okeanologii. Trudy, V 69 p. 98-177 1964.

Descriptors: *Fish behavior, Food habits, *Fish diets, Fish food organisms, Ecosystems, *Benthic fauna.
Identifiers: Trophic zones, Bering Sea, USSR.

It has been found that there are five main groups among them; sessile suspension or detritus feeders, mobile suspension feeders, selective detritus eaters, non selective detritus eaters, and carnivores. The trophical zonation of the bottom fauna in the Bering and Okhotsk Sea and the Pacific coastal line of Kamtshathka and North Kurile Islands are compared. A correlation between the trophic zones and biocoenoses was also studied. The distribution of trophic zones along the coasts of continents is discussed and charts showing the trophical zonation of the bottom fauna in the Asov and Baltic Se
are given.
W70-06460

REPRODUCTIVE PERIODICITIES OF I DOPACIFIC INVERTEBRATES IN THE GUI OF SUEZ. I. THE ECHINOI PRIONOCIDARIS BACULOSA (LAMARC AND LOVENIA ELONGATA (GRAY),
American Univ., Cairo (Egypt).
J. S. Pearse.
Available from the Clearinghouse as AD-699 29
Bulletin of Marine Science, June 1969, V. 19, N
2, p 323-350, 28 p. Prepared in cooperation wi
Kerckhoff (William G.) Marine Lab., Corona d
Mar. Calif.

Descriptors: Sea water, Fish food organisms.
Identifiers: Nutritive phagocytes, P. Baculosa, L
Elongata, Gulf of Suez, Echinoids.

Cellular changes in the gonads of the echinoi
Prionocidaris baculosa (Cidaroidea) and Lover
elongata (Spatangoidea), in the Gulf of Suez a
followed over a year. Gametogenesis leading
spawning begins in synchrony among individuals
P. baculosa in April, and spawn-out occurs in Ju
and August. Gametogenesis is not as synchrono
among individuals of L. elongata, it begins in mi
and late winter, and the prolonged spawning perio
occurs mainly between April and Septembe
Nutritive phagocytic tissue is prominent in t
gonads of both species, its globulation changi
over the year, especially in L. elongata. The nut
tive phagocytes are involved in gametogenesis
phagocytizing gametogenic cells during part of t
year and nourishing them when gametogenesis
leading toward spawning. Fluctuations
photoperiod, salinity, and sea temperature do n
seem to be directly related to the synchronizati
of reproduction, but accumulation of nutrien
perhaps indirectly related to the effects of sea te
perature and photoperiod, may have importance
synchronization.
W70-06461

COMMUNITIES OF BENTHIC FAUNA IN TH WESTERN BERING SEA,
Naval Oceanographic Office, Washington, D.C.
Z. A. Filotava, and N. G. Barsanova.
Available from the Clearinghouse as AD-699 86
$3.00 in paper copy, $0.65 in microfiche. U.
Naval Oceanographic Office Translation Was
D.C., 1969. Report No. NOO-Trans-45
Akademiya Nauk SSSR. Institut Okeanologii. Tr
dy, V 69, p. 6-97, 1964, by M. Slessers.

Descriptors: *Benthic fauna, *Fish diets, Fo
habits, Fish food organisms, Ecosystems.
Identifiers: Tropic Zones, Bering Sea, USSR.

The data on the composition and distribution of t
bottom fauna in the western Bering Sea we
received in 1950-1952. During that period 256 s
tions were occupied. One hundred seventy-thr
quantitative samples of the bottom fauna we
taken with large bottom-sampler 'Ocean-50' a
Petersen grab and 64 samples were gathered wi
Sigsbye trawl. Forty-six of the stations were occ
pied at the depths exceeding 1000m and 38
them--at depths exceeding 2000m. Eighteen co
munities of the bottom fauna were established
western Bering Sea. True oceanic deep-sea spec
are dominant in the abyssal bottom-fauna comm
nities of the western Bering Sea. Some species
ing presumably on the slope of the shelf are t
leading forms of bathyal communities. A gre
many arctic-circumpolar, arctic-boreal, and nort
boreal Pacific species of the bottom fauna are pa
of the composition of the shallow-water commu
ties of the western Bering Sea.
W70-06462

ANNOTATED BIBLIOGRAPHY OF RESOURC USE, TEXAS GULF COAST,
Texas A and M Univ., College Station.
Clare A. Gunn.

able from the Clearinghouse as PB-189 780,) in paper copy, $0.65 in microfiche. Texas A M University Sea Grant Publication No 204, ember 1969. 387 p, 2 map, 5 index.

riptors: *Bibliographies, *Texas, *Gulf tal Plain, *Natural resources, Land use, Oil, eation, Fisheries, Wildlife, Water resources, aries, Climates, Topography, Soils, Vegeta-

tifiers: Texas Gulf Coast.

nnotated bibliography of approximately 2300 ences is presented of uses of all natural urces of the Texas Gulf Coast. The geographic rage reaches from the Louisiana border to the dary with Mexico and includes a ribbon of about 75 miles wide and that portion of the of Mexico within 10 1/2 miles of the coast. All es in the natural resource categories such as cli-, wildlife, topography, soils, minerals, vegeta- cover, and water are covered. Additional gories were considered, such as space, loca-, cultural, historic, and landscape quality. All uses, considering both developed and un-eloped land, were included. The time span ns with current studies and reaches back to and uding 1950. (Knapp-USGS)
0-06578

E BEHAVIOUR OF A STABLE SALINITY ADIENT HEATED FROM BELOW,
nbridge Univ. (England). Dept. of Applied thematics and Theoretical Physics.
. Turner.
rnal of Fluid Mechanics, Vol 33, Part 1, 1968, p -200. 7 fig, 16 ref.

scriptors: *Density stratification, *Thermal tification, *Model studies, *Salinity, Heated er, Boundary layers.

s study investigates theoretically and by labora- y experiments the motions resulting when a ear, stable salt gradient is heated uniformly and a steady rate from below. A convecting, growing er is first formed whose depth temperature and nity differences from the fluid above are all in- asing as t (1/2). The way in which these quanti- s depend on the salinity gradient and heating rate also predicted, and verified experimentally. A bility criterion is then developed which scribes the breakdown of the diffusive boundary er ahead of the advancing front, and leads to an pression for the thickness of the bottom layer en a second layer forms above it. The predicted m of dependence of layer thickness on the given rameters is again borne out by the experiments. me conclusions are: (a) The results obtained int out the importance of bottom heating com- red with that from the sides during the growth of e lowest layer. (b) Experiment agrees with the eory based on a negligible extra entrainment at e top of the layer due to the conversion of turbu- nt kinetic to potential energy; but remain the oubt whether this would continue to be true on a uch larger scale. (c) With these results, it is possi- e to determine when a new layer will form given e heating rate and salinity gradient. (Guerrero-anderbilt)
70-06636

NTERNAL WAVES IN A CONTINUOUSLY TRATIFIED ATMOSPHERE OR OCEAN,
alifornia Univ., San Diego, La Jolla. Inst. of eophysics and Planetary Physics.
ohn W. Miles.
ournal of Fluid Mechanics, Vol 28, Part 2, 1967, p 05-310. 1 tab, 9 ref.

escriptors: *Stratified flow, *Density stratifica- on, Ocean waves, Waves (Water).
dentifiers: *Richardson number, *Internal waves.

his study investigates a stably stratified shear flow hich has the velocity profile V (1-e to the power -y/h)) and the density profile log (rho sub 0)/rho = alpha (1-e to the power (-y/h)) in O<y< infinity and is bounded by the rigid plane y=o. It was proved that small disturbances with respect to this basic flow are stable for all wave lengths and Richardson numbers. The eigenvalues for neutral disturbances (internal gravity waves) are enumerated. Another conclusion is that the heterogeneous shear flow analyzed will support an infinite number of internal gravity waves with wave speeds that lie outside of the range of wind speeds, (O, V), but have limited points at c=O- for J> 1/4 and at c=O+ for J=O+. The results are applicable to the atmosphere and to an infinitely deep ocean. (Guerrero-Vanderbilt)
W70-06637

SOME OBSERVATIONS OF THE OCCURRENCE OF TURBULENCE IN AND ABOVE THE THERMOCLINE,
Defence Research Establishment Pacific, Victoria (British Columbia).
H. L. Grant, A. Moilliet, and W. M. Vogel.
Journal of Fluid Mechanics, Vol 34, Part 3, 1968, p 443-448. 5 fig, 3 ref, 1 tab.

Descriptors: *Thermocline, *Turbulence, *Temperature, *Stratification, Boundary layers, Oceans.

Some observations of small-scale velocity and temperature fluctuations in the upper layers of the ocean are described. A hot film flowmeter, a thin film resistance thermometer and several thermistors were mounted on a submarine and used to study turbulence and temperature microstructure in the open sea. The observations were made in the west coast of Vancouver Island. Conclusions were (a) The surface layer was found to be continuously turbulent and (b) patches of turbulence were found in and below the main ocean thermocline. The temperature structure in the thermocline was observed to be very complex with spots of vigorous turbulent mixing. (Guerrero-Vanderbilt)
W70-06645

WAVE-INDUCED SHEAR INSTABILITY IN THE SUMMER THERMOCLINE,
British Meteorological Office, Bracknell (England).
J. D. Woods.
Journal of Fluid Mechanics, Vol 32, Part 4, 1968, p 791-800. 14 fig, 19 ref.

Descriptors: *Thermocline, *Stability, *Turbulence, Temperature, Flow, Oceans.
Identifiers: *Mediterranean Sea, Malta, Temperature gradient.

This paper describes the principal fine-scale features of the summer thermocline and to establish, with the help of field observations and a simple theory, one of the major mechanisms by which its structure is controlled. The field observations were taken in the Mediterranean Sea around Malta, using a new temperature-gradient meter suitable for sounding to a maximum depth of 50 m from a small open boat and make spot measurements of temperature and temperature gradient. The thermistors had a response time of a few tenths of a second and were calibrated to plus or minus 0.01 deg C. Measurements of temperature gradients were made during the probe's descent and temperature during the subsequent ascent. In order to measure the shear across thermocline sheets, a sequence of photographs of the steady distortion of a vertical streak of dye left behind in the wake of a small pellet of soluble flureseein was taken. The principal internal feature of the thermocline is a series of thin, laminar-flow sheets of high static stability, separated by a weakly turbulent layer of only moderate density gradient and a few meters thick. A mechanism for generating the patches of turbulence observed on these thermocline sheets is established by comparing dye photographs with a theory of Miles and Howard. (Guerrero-Vanderbilt)
W70-06650

THE BALANCE BETWEEN LIVING AND DEAD MATTER IN THE OCEANS,
Kiel Univ. (West Germany). Institut fuer Meereskunde.
Johannes Krey.
International Oceanographic Congress, New York, Publication No 67, 1959. 22 ref.

Descriptors: *Balance of nature, *Oceans, Phytoplankton, Zooplankton, Nutrients, Light, Turbulence, Tripton, Standing crop, Detritus, Productivity, Chlorophyll, Proteins, Bacteria, Currents (Water), Phosphorus, Nitrogen, Copepods, Environment.
Identifiers: *Living matter, *Dead matter, Oscillating balance.

Investigation of the balance in nature between living and dead matter in oceans requires a quasi-stable state, an area and a period of time sufficiently large, such as the Atlantic Ocean, where the general bare line of population density is relatively constant. The web of relationships involves phytoplankton, zooplankton, limiting nutrients, light, water turbulence, and tripton. Knowledge of phytoplankton assimilation potential and especially of the reverse, decomposition under natural conditions, is relatively limited; these two processes should be related to proteins. Information is needed about the physiological response of zooplankton, its metabolisms and nutrient requirements; the respiration processes of zooplankton and bacteria, and the processes which bring nutrient-rich water to the surface are particularly interesting. The role of heavy oceanic storms should not be underestimated in their effect on nutrient supply. More should be known about the annual cycle of light in different ocean areas and various depths and their relationship to basic productivity. A balanced biocoenosis is theoretical--every balance must be exactly defined. The oscillating balance is actually an open unbalanced system. Heterogeneous conditions and their dynamics must be considered. (Jones-Wisconsin)
W70-06652

MARINE BACTERIA AND OTHER HETEROTROPHS AS FOOD FOR ZOOPLANKTON IN THE STRAIT OF GEORGIA DURING THE WINTER,
Fisheries Research Board, Nanaimo (British Columbia). Biological Station.
H. Seki, and Owen D. Kennedy.
Journal Fisheries Research Board of Canada, Vol 26, No 12, p 3165-3173, 1969. 5 fig, 2 tab, 27 ref.

Descriptors: *Marine bacteria, *Zooplankton, *Foods, *Winter, Microorganisms, Detritus, Standing crop, Copepods, Sampling, Yeasts, Biomass, Phytoplankton, Growth rates, Nutrients, Food chains, Chlorophyll, Sediments, Depth, Seston, Fungi, Protozoa, Pseudomonas, Oceans.
Identifiers: *Heterotrophs, *Strait of Georgia (Canada), Euphotic zone, Glucose uptake, Pseudocalanus minutus, Acartia longiremis, Oithona spinirostris, Coscinodiscus, Sagitta, Pleurobrachia, Metschnikowia.

Indications point that primary productivity in autumn and winter is low and standing crops of particulate carbon and nitrogen in the sea are minimal. The number of zooplankton nauplii in winter are often between 1-10 per liter. Heterotrophic microorganisms may be especially important in nutrient cycles and the food chain during these periods. Microbiological investigation was made in the Strait of Georgia during winter to study occurrence of heterotrophic microorganisms in relation to other particulate organic materials, including plankton and detritus. High microbial activity was measured in the euphotic zone, where marine bacteria and allied microorganisms were chiefly found on particulate matter having diameter below 25 microns. Their standing crop was estimated to be between 40 and 3000 milligrams carbon/square meter. Some of this was consumed by zooplankton, which were found to have concentrated bacteria by a factor of around 100,000. Only the highest levels of microbial production were estimated to be suffi-

cient for zooplankton growth and generally bacterial activity was only sufficient to support marine copepods at subsistence levels in the Strait of Georgia. (Jones-Wisconsin)
W70-06666

ECONOMIC EVALUATION OF WATER QUALITY: A MULTICOMPONENT MODEL OF OPTIMAL QUALITY CONTROL IN ESTUARINE WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06684

DIVERGENCE OF ISOBATHS AS A CAUSE OF CURRENT BRANCHING,
Woods Hole Oceanographic Institution, Mass.
Bruce A. Warren.
Available from the Clearinghouse as AD-698 970, $3.00 in paper copy, $0.65 in microfiche. Deep Sea Research, V. 16 Suppl., p. 339-355, 1969.

Descriptors: Flow profiles, Vortices, Bathythermographs, Flow, Mathematical models, Oceanography, Stratification.
Identifiers: Isobaths, Rossby number, Gulf stream, Depth finding, Newfoundland.

Southeast of the Grand Banks of Newfoundland, the Gulf Stream splits into two branches in an area where the underlying bottom contours spread markedly apart. The effect of divergent isobaths on a barotropic, quasi-geostrophic current is investigated under the condition of conservation of potential vorticity. The result found is that if the ratio of half the fractional depth change across the current, to the appropriate Rossby number, exceeds some critical value of order unity, then the streamlines will tend to follow the isobaths, and the current branches, if the ratio is less than the critical value, the current simply narrows and intensifies. The ratio for the Gulf Stream, suitably redefined for equivalent-barotropic flow, may be just large enough for the Stream to branch as observed. Theoretical deficiencies and observational uncertainties are stressed.
W70-06707

PHYTOL-DERIVED C19 DI- AND TRIOLEFINIC HYDROCARBONS IN MARINE ZOOPLANKTON AND FISHES,
Woods Hole Oceanographic Institution, Mass.
M. Blumer, J. C. Robertson, J. E. Gordon, and J. Sass.
Available from the Clearinghouse as AD-698 971, $3.00 in paper copy, $0.65 in microfiche. Published in Biochemistry, V. 8, No. 10, p. 4067-4074, Oct 19, 1969.

Descriptors: *Plankton, *Fish, *Aquatic micro organisms, Lipids, Nuclear magnetic resonance, Chromatography, Food chains, Zooplankton.
Identifiers: Pentadecadienes, Pentadecatrienes, Alkanes, Dienes.

Three phytol-derived olefinic hydrocarbons were isolated from marine zooplankton and fishes. Their structures have been determined by ultraviolet, infrared, nuclear magnetic resonance, and mass spectrometry and by combined gas chromatography and mass spectrometry of their ozonolysis products. They are the 2,10- and 5,10-diene and the 2,6,10-triene analogs of pristane (2,6,10,14-tetramethylpentadecane). The presumed mode of formation of these and related olefins and their fate in the marine food chain and in marine sediments is discussed. Because of their relative stability, these and related hydrocarbons provide tracers for the study of dynamic processes in the marine food chain. These olefins are not present in ancient sediments and in petroleum; therefore, they are valuable markers for the distinction between marine hydrocarbons derived from organisms and from oil pollution.
W70-06708

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

FURTHER STUDIES OF PROPERTIES OF SEA WATER AND ITS CONCENTRATES TO 200 DEG C,
California Univ., Berkeley.
L. A. Bromley.
Report available for sale by Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.50. Office of Saline Water Research and Development Progress Report No 522, March 1970. 166 p, 30 fig, 24 tab, 34 ref, 2 append. OSW Contract No 14-01-0001-763.

Descriptors: *Water properties, *Sea water, *Water chemistry, *Thermodynamic behavior, *Desalination, Electrolytes, Physicochemical properties, Enthalpy, Viscosity, Mixing, Saline water, Aqueous solutions, Salinity, Heat, Boiling.
Identifiers: Sea water properties.

Measurements of the heat capacity of sea water solutions to 200 deg C and up to 12% salinity are reported. Included are smoothed values for Cp, Csat, and the partial and apparent values for salts and water. These have been combined, together with relative enthalpy values determined at 25 deg C, also as a result of this study, to give enthalpy values for liquid sloutions (at thermal saturation). Heats of mixing measured at 50 deg C are shown to be consistent with these measured values. Some preliminary work on other electrolyte solutions is included. Progress is reported in attempts to measure boiling point elevations accurate to 0.001 deg C. Accurate measurements of viscosity of sea water solutions at 20 deg C are complete and smoothed values included. Graphs are also included for values at 40 and 60 deg C. Progress on equipment for measurements of viscosity to 150 deg C is reported. (Knapp-USGS)
W70-06331

FINAL REPORT ON INVESTIGATION OF DESALINATION BY FREEZING,
Westinghouse Research Labs., Pittsburgh, Pa.
R. G. Seidensticker, and R. F. Sekerka.
Report for sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $0.75. Office of Saline Water Research and Development Progress Report No 517, March 1970. 78 p, 20 fig, 8 ref. OSW Contract No 14-01-0001-1336.

Descriptors: *Desalination processes, *Freezing, Research and development, Reviews, Water chemistry, Thermodynamics, Chemical reactions.
Identifiers: Freezing desalination.

Progress in desalination by separation or partitioning of solute between a saline solution and ice frozen from this solution is reviewed. The effective distribution of solute between a liquid and a growing solid phase is governed not only by the equilibrium partitioning characteristics, but also by the transport of rejected solute away from the interface. A Green's function method was developed to handle this problem for the difficult case of the scalloped interface frequently encountered in real freezing situations. A method was derived for determining the solute distribution in a solid when the partitioning is a function of concentration. A review of partitioning theory considers the possible causes for concentration dependent partitioning in ice. In addition to the theoretical work, the results are presented of measurements of the partitioning of HCl, NaOH, NaCl and ammonium chloride as a function of concentration. Freezing potentials were measured and a linear voltage-velocity relationship was found for dilute NaCl solutions. (Knapp-USGS)
W70-06335

RESEARCH ON NEW ION-ADSORPTI ELECTRODES FOR DEMINERALIZATION SALINE WATER,
General Electric Co., Schenectady, N.Y.
T. O. Rouse, and A. Factor.
Report available for sale from Superintendent Documents, U S Government Printing Offi Wash, D C 20402 - Price $0.65. Office of Sal Water Research and Development Progress Rep No 524, April 1970. 60 p, 10 fig, 10 tab, 23 OSW Contract No 14-01-0001-612.

Descriptors: *Desalination processes, *El trochemistry, *Electrodes, Electrolytes, Solubil Water yield, Oxidation, Reduction (Chemical). Identifiers: Ion adsorption.

This report summarizes the results of a resea program on new ion adsorption electrodes for demineralization of water. Polymers containing idizable or reducible organic groups thought ca ble of providing the necessary electrochemi reactivity and ion adsorption properties w synthesized and tested. A number of monome materials were also examined in order to prov insight into the necessary synthetic and el trochemical behavior. Of these, only polyviologens and TCNQ were found to give hi reproducible electrochemical reactivity and ion sorption. TCNQ was found to remove sodium calcium ions from solution through the catho formation of slightly soluble salts. Sodium i were preferentially removed in the presence of cium ions. Solubility in the electrolyte and incre ing inaccessibility of the salt in the porous el trode structure limit the usefulness of TCNQ in application. The insoluble polyelectrolyte comp formed by polymeric viologen cations polystyrene sulfonate, when precipitated on g phite powder, resulted in electrodes with cation sorption capacities up to about 0.5 meg/g. reaction mechanisms for the polyviologens w examined in some detail. This and possible rou to optimized electrodes are discussed. (Kna USGS)
W70-06510

REVERSE OSMOSIS OFFERS USEF TECHNIQUE FOR DESALTING,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-06592

3B. Water Yield Improvement

EVALUATION OF THE EFFECT OF IMPOUN MENT ON WATER QUALITY IN CHEN RESERVOIR,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 05C.
W70-06336

REGIONAL DISCRIMINATION OF CHANGE RUNOFF,
Colorado State Univ., Fort Collins. Dept. of C Engineering.
For primary bibliographic entry see Field 02E.
W70-06346

INFLUENCE OF MAN ON THE HYDROLO CAL CYCLE--GUIDE TO POLICIES FOR T SAFE DEVELOPMENT OF LAND AND WAT RESOURCES.
Food and Agriculture Organization of the Uni Nations.
For primary bibliographic entry see Field 06B.
W70-06370

LIQUID-LIMIT DETERMINATION FOR DICATING EFFECTIVENESS OF CHEMICA IN POND SEALING,
Tennessee Univ., Knoxville.
J. I. Sewell, and C. R. Mote.
Trans Amer Soc Agr Eng, Vol 12, No 5, p 611-6 Sept-Oct 1969. 3 p, 6 fig, 3 tab, 6 ref.

riptors: Ponds, *Soil sealants, Seepage, meability, Dispersing agents, *Liquid limits, rvoirs, Plasticity index, Reservoir leakage, , Soil properties, Soil mechanics.
tifiers: Soil plasticity, *Seepage control, neability tests, Canal sealants, Sodium car- ite, Sodium phosphates, *Chemical sealants.

d and accurate methods are needed for select- hemical pond sealers and determining applica- rates for a given soil. A probably satisfactory nod involves running standard constant-head neability tests on treated soil samples, but con- rable laboratory equipment may be required at least 30 days delay to reach steady-state per- meter discharge rates may be necessary. A ker and simpler method for evaluating chemi- treatment of some soils would be determining decrease in liquid-limit from chemical treat- t. Chemical dispersing agents used as pond ers break soil aggregates into finer particles, ace soil permeability, and increase fluidity of soil-water system; and determination of liquid- t is a method for measuring changes in the dity of the soil-water system. Laboratory tests de on 7 Tennessee soils treated with sodium car- nate and sodium pyrophosphate evaluated the uracy of liquid-limit as a measurement of meability. Results showed liquid-limit correla- n with permeability for 5 plastic soils, and no relations for a soil of plasticity and a soil of low sticity. (USBR)
70-06374

I INVESTIGATION OF WATER SURFACE EMPERATURE BY AN AIRBORNE IN- ARED RADIOMETER: LAKE HEFNER, KLAHOMA,
olorado State Univ., Fort Collins. Dept. of At- spheric Science.
. E. Marlatt, and R. L. Grossman.
vailable from Clearinghouse as PB-180 336, .00 in paper copy, $0.65 in microfiche. Colorado ate University, Department of Atmospheric ience, Final Report to Bureau of Reclamation, nuary 1968. 118 p, 36 fig, 9 tab, 56 ref, 4 append. SBR Contract No 14-06-D-6022.

escriptors: *Water temperature, *Evaporation ntrol, *Monomolecular films, *Remote sensing, nfrared radiation, Hexadecanol, Solar radiation, eat transfer, Lakes, Evaporation, Reservoir vaporation, Oklahoma.
dentifiers: Lake Hefner (Okla).

he effect of a monomolecular film of hexadecanol n the surface temperature of Lake Hefner, Oklahoma, was investigated using an airborne in- rared radiometer. In three of six cases studied, the nonomolecular film produced a temperature rise t the water surface. The temperature rise seems to e caused by an interaction of latent heat flux and ensible heat flux from the subsurface water. The ffect of the hexadecanol on the thermal gradient vas to reverse it, producing a 'warm skin' tempera- ure. Sensible heat transfer from subsurface water nay be responsible for maintaining a relatively constant surface temperature. A model is presented which balances cooling of surface water by fetch variation of evaporation with fetch varia- ion of sensible heat transfer from the subsurface water. (Knapp-USGS)
W70-06400

IMPORTANCE OF NATURAL VEGETATION FOR THE PROTECTION OF THE BANKS OF STREAMS, RIVERS AND CANALS,
P. Seibert.
In: Freshwater, Council of Europe, Nature and Environment Series, No 2, p 35-67, 1968. 33 p, 6 fig, 17 plate, 65 ref.

Descriptors: *Bank protection, *Bank stabilization, *Vegetation establishment, Erosion control, Riprap, Soil stabilization, Vegetation effects, Streams, Rivers, Canals, Environmental engineering, Hydraulic engineering, Social aspects.
Identifiers: Environmental planning.

In the course of history various methods have been successively evolved to strengthen the banks of rivers, streams and canals. Since the last century, the most common of them have relied mainly on inanimate materials; wood, stone, concrete and even iron have been used in various ways for protecting banks. The most important forms of protection are piles, wooden sleepers, slats or planks, wattling, fascines, fascine rolls, mattresses, enrockment, stone revetment, stone facings, paving, flagging with natural stone or concrete, stone-filled mattresses, gabions, metal sheet-piling, and concrete structures of every type. The utilization of living plants instead of or in conjunction with inanimate construction materials has many advantages. The degree of protection, which may be low to start with, increases as the plants grow and spread. The repair and maintenance of inert materials is replaced by the care of the riparian plants. The utilization of living plants for the protection of banks, embankments, promontories and slopes is the chief characteristic of close-to-nature hydraulic engineering. At the same time, it brings about a biological improvement of the site and of the waters and enhances the landscape. (Knapp-USGS)
W70-06401

WATER SUPPLIES FOR SELECTED SITES IN OLYMPIC NATIONAL PARK, WASHINGTON,
Geological Survey, Tacoma, Wash.
Kenneth L. Walters.
Geological Survey Open-file report, 1970. 72 p, 4 fig, 5 tab, 7 ref.

Descriptors: *Water supply, *Groundwater, *Surface waters, *National parks, *Washington, Water wells, Water yield, Water quality, Aquifers, Alluvium, Streamflow, Weather, Rainfall, Springs, Water resources development.
Identifiers: Olympic National Park.

The use of Olympic National Park, Washington is increasing to the extent that existing water-supply systems are becoming inadequate. Wells, springs, and streams were evaluated as possible sources of supply. Recorded average annual precipitation within or near the park ranges from about 17 inches to about 134 inches, but locally the annual precipitation may exceed 200 inches. The greatest precipitation occurs at the higher elevations in the western interior of the park, and the least occurs in the lowlands in the northeast part of the park, near Sequim. Several of the large rivers are undesirable as sources of water supply because they are fed by glacier melt water that contains much finely divided rock material. Also, many of the smaller streams, especially those near the Pacific Coast and in the areas of highest precipitation in the interior area, often carry water that is highly colored by decomposing vegetation. Aquifers of potentially substantial yields are restricted largely to alluvial or glacial deposits. Yields of several hundred gallons per minute probably are available only from wells tapping the alluvium of the lower Quinault and Quillayute valleys, or deltaic deposits at Fairholm and Barnes Point on Lake Crescent. (Knapp-USGS)
W70-06520

WATER RESOURCES IN THE BIG LOST RIVER BASIN, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, Idaho.
E. G. Crosthwaite, C. A. Thomas, and K. L. Dyer.
Geological Survey Open-file report, 1970. 109 p, 31 fig, 12 tab, 36 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Idaho, Conjunctive use, Surface-groundwater relationships, Water wells, Aquifers, Alluvium, Limestones, Basalts, Water levels, Water yield, Transmissivity, Streamflow, Irrigation water, Water utilization, Water quality, Safe yield.
Identifiers: Big Lost River basin (Idaho).

The Big Lost River basin occupies about 1,400 square miles in south-central Idaho and drains to the Snake River plain. The economy in the area is based on irrigation agriculture and stockraising. The principal aquifer is unconsolidated alluvial fill that is several thousand feet thick in the main valley. Carbonate rocks are the major bedrock aquifer. Only the alluvium, carbonate rock and locally the basalt yield significant amounts of water. Average annual precipitation ranged from 8 inches on the valley floor to about 50 inches at some higher elevations during the base period 1944-68. The estimated water yield of the Big Lost River basin averaged 650 cfs for the base period. A distinctive feature of the Big Lost River basin is the large interchange of water from surface streams into the ground and from the ground into the surface streams. The estimated 425 cfs that leaves the basin as groundwater flow is more than adequate for present and foreseeable needs. Both the surface and groundwaters are of good quality and are suitable for most uses. Although these waters are low in total dissolved solids, they tend to be hard or very hard. (Knapp-USGS)
W70-06529

WATER REPELLENCY AND INFILTRATION RESISTANCE OF ORGANIC-FILM-COATED SOILS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation. Lab.
D. H. Fink.
Soil Science Society of America Proceedings, Vol 34, No 2, p 189-194, March-April 1970. 6 p, 7 fig, 2 tab, 18 ref.

Descriptors: *Water yield improvement, *Wettability, *Infiltration, *Films, *Soil water movement, Organic compounds, Coatings, Monomolecular films, Moisture tension, Surface tension, Soil physical properties, Soil chemical properties, Porosity.
Identifiers: Water repellent soils.

Water repellency and infiltration resistance of porous soils coated with a variety of thin, organic films were examined. The effective contact angle of water on these treated soils was found to be a function of (1) the structure of the hydrophobic portion of the organic admolecules, and (2) the proportion of soil surface covered with the organic film, but was relatively independent of soil chemical and physical properties. Effective angles as high as 150 to 160 deg were recorded for several types of organic materials. These included several silcone water repellents, an amine- and a hydroxy-substituted phenol, and an acetic acid salt of a long-chain fatty amine. The breakthrough pressure was directly affected by the factors that controlled the contact angle, and was inversely related to the effective pore radii of the porous, water-repellent soils. (Knapp-USGS)
W70-06531

WATER SUPPLIES FOR ARID REGIONS.
American Association for the Advancement of Science, Washington, D.C.

Edited by J Linton Gardner and Lloyd E Myers. Contribution No 10 of The Committee on Desert and Arid Zones Research Southwestern and Rocky Mountain Division, A.A.A.S., Symposium held May 1-2, 1967, the Univ of Arizona, Tucson, 1967.

Descriptors: *Water conservation, *Water utilization, *Water yield improvement, Water conveyance, Water consumption, *Water harvesting, Weather modification, Cloud seeding, Water storage, Evaporation control, Water transfer, Irrigation water, Saline water, Seepage control, *Arid lands, Arid climates.

Water supply problems in arid regions cannot be solved unless all aspects of the problems are given proper consideration. Obtaining additional water by importation, desalination, cloud seeding, or increasing precipitation runoff from watersheds is necessary but not sufficient. Attention must also be paid to water pollution, alternative water uses, reuse of water, and the accumulation of salt in groundwater and soils. These problems are particu-

larly acute in arid regions where water supplies are limited and harmful salts and wastes are not removed by an outflow of water from the regions. Some of these problems are discussed in the following papers of this Symposium. (See also W70-06678 thru W70-06683).
W70-06677

PROJECT SKYWATER,
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.
J. Robert Stinson.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 10-22, 1967.

Descriptors: *Cloud seeding, *Weather modification, *Precipitation (Atmospheric), *Artificial precipitation, *Silver iodide, Rainfall, Snow, Clouds, Colorado River Basin, Great Basin, Pacific Northwest U.S., Missouri River, Rio Grande, Semiarid climates, Climatic data, Laboratory tests, Meteorology, On-site-investigations.
Identifiers: *Project Skywater.

Project Skywater is a government program mainly concerned with cloud treatment. This treatment is generally accomplished by seeding with AgI. The project is concentrating on such problems as the amount and type of seeding material used and the amount and location of the resulting precipitation. The results of extensive laboratory studies are outlined. Field studies in the Colorado River Basin, Missouri River Basin, Rio Grande River Basin, Great Basin, Pacific Northwest, and southern Sierra Nevada Mountains are also discussed. (See also W70-06677). (Carr-Arizona)
W70-06678

PRECIPITATION RUNOFF INDUCEMENT,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Lloyd E. Myers.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 22-30, 1967. 16 ref

Descriptors: *Runoff, *Water harvesting, *Water conservation, *Arid lands, *Semiarid climates, Watershed management, Land use, Streamflow, Precipitation (Atmospheric), Brush control, Soil treatment, Water yield improvement, Vegetation effects, Soil treatment, Soil sealants, Soil surfaces, Asphalt, Multiple-purpose projects, Watersheds (Basins)
Identifiers: Vegetation management

Large quantities of water are potentially available in arid and semiarid regions of the United States. Since useable streamflow is only approximately 2% of the total rainfall, part of the remaining 98% which does not go into streamflow can be harvested. A variety of water harvesting methods are being developed, including vegetation management, chemical soil treatment, and use of ground covers. Harvesting should be a benefit to other land uses and should not conflict with recreation, timber production, and grazing. It can be used in conjunction with other conservation practices to relieve the water shortage problem of the arid lands. (See also W70-06677). (Carr-Arizona)
W70-06679

WATER STORAGE,
Agricultural Research Service, Logan, Utah. Soil and Water Conservation Research Div., and Utah Agricultural Experiment Station, Logan.
C. W. Lauritzen.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 31-37, 1967. 11 ref.

Descriptors: *Water storage, *Structures, *Seepage, *Evaporation, *Evaporation control, Storage, Storage tanks, Reservoirs, Reservoir design, Reservoir leakage, Water loss, Reservoir evaporation, Hexadecanol, Arid lands, Watertight, Linings, Plastics, Soil sealants, Elastomers, Irrigation efficiency, Earth materials, Membranes, Films, Asphalt, Costs, Storage tanks.
Identifiers: *Seepage control, Covered reservoirs.

Seepage and evaporation are major water storage problems in the arid lands. Evaporation and seepage can be controlled by storing small quantities of water in sealed structures such as steel tanks or bags. For large amount of water stored in earth structures, seepage is controlled through the use of soil sealants, plastic film, and elastomeric sheeting. Evaporation on large reservoirs is lessened to some extent by restricting water surface area and applying hexadecanol. Floating covers are also being tested, but there is presently no practical economic method for evaporation control on large water bodies. (See also W70-06677). (Carr-Arizona)
W70-06680

THE LONG DRINK: WATER CONVEYANCE IN NATURAL AND ARTIFICIAL CHANNELS,
H. Shipley.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on desert and Arid Zones Research, Contribution No 10, p 38-44, 1967. 3 fig.

Descriptors: *Water conveyance, *Arizona, *River flow, *Irrigation, *Watershed management, Watersheds (Basins), Precipitation (Atmospheric), Runoff, Water reuse, Water storage, Overdraft, Recharge, Water conservation, Arid lands, Intermittent streams, Irrigation efficiency, Municipal water, Water yield improvement.
Identifiers: *Salt River Project, *Salt River Valley Water Users' Association.

The author discusses the facets of water management and delivery in the Salt River Project System of Arizona. Among the questions considered are irregular flow of the Salt and Verde Rivers, decline in average annual rainfall in the Salt River Project watersheds, decreasing runoff, and watershed management to combat the runoff problem. Other areas covered include water conservation techniques, water supply augmentation, urban water use, and water reuse. (See also W70-06677). (Carr-Arizona)
W70-06681

WATER QUALITY PROBLEMS PECULIAR TO ARID REGIONS,
New Mexico State Univ., University Park. Dept. of Soil Chemistry.
H. E. Dregne.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A. A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 45-53, 1967. 13 tab.

Descriptors: *Salinity, *Impaired water quality, *Water quality, *Water pollution sources, *Arid lands, Semiarid climates, Irrigation, Hardness (Water), Fluorine, Fluorides, Boron, Salts, Turbidity, Water temperature, Sewage effluents, Mine wastes, Oil wastes, Brine disposal, Potable water, Irrigation water, Municipal water, Industrial water.

Water quality problems of arid regions are similar to those of humid regions in kind but not in magnitude. Hardness, fluorine tolerance, boron, salinity, turbidity, and temperature are all greater problems in arid lands. Oil field wastes, mine wastes, sewage effluent, and nutrient content are other water quality problems that are accentuated in arid regions. Oil field and mine wastes are aird lands problems due to the fact that most such mining is concentrated in the arid western regions of the U.S. (See also W70-06677). (Carr-Arizona)
W70-06682

THE SALINITY PROBLEM IN REUSE O WATER,
Utah Water Research Lab., Logan.
Jay M. Bagley.
In: J. L. Gardner and L. E. Myers, eds., Water Su plies for Arid Regions, A.A.A.S., Southwestern a Rocky Mountain Division, Committee on Des and Arid Zones Research Contribution No 10, 54-62, 1967. 11 ref.

Descriptors: *Water reuse, *Salinity, *Sali water, *Salts, *Water quality, Colorado Riv Basin, Impaired water quality, Irrigation, Irrigati water, Streamflow, Water pollution sources, Riv basins, Municipal wastes, Industrial wastes, Was disposal, Arid lands, Salt balance, Mineralog Return flow, Interstate compacts, Waste wat (Pollution).
Identifiers: Recycling, Mineral content.

If water is to be reused, provision must be made f its reconditioning. Unfortunately, mineral salts c pass through a treatment process practica unchanged and built up salinity could seriou limit increasing water reuse. The problems of reu and salinity are considered in the context of riv basins, municipalities, industry, and irrigation, w particular emphasis on the Colorado River syste Establishment of salinity concentration limi better regulation of natural streamflow and was discharge, and other techniques to reduce salin are discussed. (See also W70-06677). (Ca Arizona)
W70-06683

PROJECT SKYWATER, 1969 ANNUAL R PORT.
Bureau of Reclamation, Denver, Colo. Office Atmospheric Water Resources.

Report No. REC-OCE-70-13, March 1970. 511 p

Descriptors: *Weather modification, *Cloud see ing, *Precipitation (Atmospheric), *Artifici precipitation, *Silver Iodide, Climatology, Clo physics, Model studies, Colorado River Basi Ecology, Water Resources development, Rada Statistical methods, Great Plains, Instrumentation

The report represents the fiscal year 1969 activiti and accomplishments of the Bureau of Reclam tion's Atmospheric Water Resources Program. Th objective of this weather modification program to provide precipitation management technolo for use involving the Nation's water resourc problems. A short introductory section summariz activities in the categories of winter field program summer field programs, nonfield programs, a pilot projects. The bulk of the document consists reports prepared by Bureau of Reclamation co tractors in which they summarize their FY 69 a tivities.
W70-06703

3C. Use of Water of Impaired Quality

GROUNDWATER SUPPLY OF CAPE HA TERAS NATIONAL SEASHORE RECRE TIONAL AREA, NORTH CAROLINA - PART 6
Geological Survey, Raleigh, N.C.
For primary bibliographic entry see Field 04B
W70-06399

THE SALINITY PROBLEM IN REUSE O WATER,
Utah Water Research Lab., Logan
For primary bibliographic entry see Field 03B.
W70-06683

Conservation in Domestic and unicipal Use

OF BAYONNE V WATER SUPPLY M'N (DECLARATORY JUDGMENT RE-DING WATER SUPPLY CONTRACTS VEEN WATER COMMISSION AND MU-PALITY).

J Super 409, 105 A2d 19-26 (N J Super Ct)

riptors: *New Jersey, *Cities, *Administrative cies, *Water supply, Water costs, Water rates, ial decisions, Legal aspects, Regulation, Con- Water resources, Reservoirs, State govern-s, Local governments, Water works, Legisla- Dams, Structures, Water distribution (Ap-), Water demand, Water delivery, Utilities, ibution, Domestic water, Municipal water.

tiff city brought suit for a declaratory ment seeking a construction of a New Jersey te which provided that defendant water supply mission may contract with a municipality for supply of water in consideration for an equita-hare of the cost of constructing and operating a supply plant. The court held that the statute ired defendant to supply water to plaintiff if an quate supply existed. The state is under a duty ontrol and conserve its water resources for the efit of all its inhabitants, and it was for this on that the defendant commission was created. endant is required to hold its water supply ts in trust for the municipalities. Plaintiff could be denied access to unused water because the ds of prior contracting municipalities might in-se in the future. An equitable share of the cost such supply was reached following a study of tinent facts. (Barnett-Florida)
0-06715

MPHIS POWER AND LIGHT CO V CITY OF MPHIS (CITY'S CONTROL OF PUBLIC ILITIES).
2 SW2d 817-825 (Tenn 1937)

scriptors: *Tennessee, *Tennessee Valley thority Project, *Power marketing, *Water pply, Public utilities, Municipal water, Cities, onomies, Federal government, Electric power, ter distribution (Applied), Contracts, Electric wer costs, Monopoly, Electric power rates, Judi-l decisions, Administrative agencies.

intiff electric company sought an injunction to event the city of Memphis from proceeding der contracts with the Tennessee Valley thority and the Federal Public Works Adminis-tion. The city contended the contracts in estion created a monopoly in violation of the ate Constitution. The Supreme Court of Tennes-e stated that no exclusive right to distribute elec-city was conferred upon the city. Also, an exclu-ve franchise to furnish water or light in a particu-r city did not constitute a monopoly. (Hubener-orida)
70-06721

ILLIS V WILKINS (BENEFICIAL USE OF IPARIAN LAND MUST BE CONSIDERED BY UBLIC AGENCIES).
2 A2d 321-324 (N H 1943)

Descriptors: *New Hampshire, *Public health, Riparian rights, *Beneficial use, Lakes, Lake ice, udicial decisions, Water law, Bacteria, Aquatic acteria, Coliforms, Water pollution sources, Swimming, Local governments, State governments, Administrative agencies, Pond, Relative rights, Regulation, Abatement, Inspection, Administrative decisions, Property values.

Plaintiffs, riparian owners, sought judicial review of a State Board of Health ruling prohibiting further swimming in a lake which served as a municipal water supply. The trial court upheld the ruling as necessary to protect public health. The appellate court held that plaintiffs, as riparian owners, possessed rights in the enjoyment of the pond greater than those of members of the general public. The court stated that the importance of the public benefit must be balanced against the seriousness of the rights restricted. Since the trial court failed to take into account the decrease in property value caused by the ruling in comparison with the cost of restructuring the city water intake system and purifying the water, the cause was reversed, and a new trial was ordered. (Hubener-Florida)
W70-06723

3F. Conservation in Agriculture

EVALUATION OF EFFICIENCY IN ALLOCATING CONTRACT RESEARCH FUNDS BY THE COLORADO WATER CONSERVATION BOARD,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 06C.
W70-06452

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

ENVIRONMENTAL AND TECHNICAL FACTORS FOR OPEN DRAINAGE CHANNELS IN MILWAUKEE,
American Society of Civil Engineers, New York.
Ted B. Prawdzik.
Available from the Clearinghouse as PB-191 710, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 12, Urban Water Resources Research Program, February 1970. 37 p, 10 fig. OWRR Project C-1536, Contract 14-01-0001-1992.

Descriptors: *Storm drains, *Flood control, *Channel improvement, *Wisconsin, *Urbanization, Open channels, Flood protection, Storm runoff, Drainage systems.
Identifiers: *Milwaukee (Wis).

Some of the environmental and technical factors which influenced the adoption of open channels for drainage in Milwaukee are outlined. Criteria are given for the selection of channel cross-sections when the improvement of existing watercourses traversing the city was essential to ameliorate flooding. The principles discussed have been applied generally in Milwaukee. The experiences the city has had with originally natural watercourses which have been improved as open storm-drain channels are discussed. (Knapp-USGS)
W70-06318

FLOOD PLAIN INFORMATION OF CUMBERLAND RIVER, POOR, CLOVER, AND MARTINS FORKS, AND CATRON CREEK, HARLAN, KENTUCKY.
Army Corps of Engineers, Nashville, Tenn.

Corps Engineers Flood Plain Report, August 1969. 57 p, 14 fig, 16 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Kentucky, Flood plains, Flood control, Non structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Harlan (Ky), Cumberland River (Ky), Standard project flood, Intermediate regional flood.

Flooding of the Cumberland River and tributaries, Harlan, Kentucky is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06328

FLOOD HAZARD INFORMATION, SANTA CRUZ RIVER, SANTA CRUZ COUNTY, ARIZONA.
Corps of Engineers, Los Angeles, Calif.

Corps of Engineers Flood Plain Report, November 1969. 14 p, 4 fig, 20 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *Arizona, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: *Santa Cruz River (Ariz), Standard project flood, Intermediate regional flood.

Flooding of the Santa Cruz River, Arizona is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06347

FLOOD PLAIN INFORMATION, ANAHOLA, KAUAI, HAWAII.
Corps of Engineers, Honolulu, Hawaii

Corps Engineers Flood Plain Report, November 1969. 21 p, 3 fig, 3 plate.

Descriptors: *Floods, *Flood damage, *Hawaii, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Tsunamis.
Identifiers: Kauai (Hawaii), Standard project flood, Intermediate regional flood.

Flooding of Anaholoa, Kauai, Hawaii is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06348

FLOOD PLAIN INFORMATION, NORTH BRANCH BIG TIMBER CREEK, CAMDEN COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

Corps of Engineers Flood Plain Report, March 1969. 49 p, 3 fig, 11 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Camden County (N J), Standard project flood, Intermediate regional flood.

Flooding of North Branch Big Timber Creek, Camden County, New Jersey is described in a report of flood plain problems based on records of rainfall,

runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06359

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 05G.
W70-06406

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
University of Southern Mississippi, Hattiesburg.
For primary bibliographic entry see Field 06B.
W70-06411

THEORY OF WATER WAVES GENERATED BY A TIME-DEPENDENT BOUNDARY DISPLACEMENT,
California Univ., Berkeley. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02H.
W70-06456

HYDRAULIC EFFICIENCY AND SPACING OF BRITISH STANDARD ROAD GULLEYS,
Road Research Lab., Crowthorne (England).
K. Russam.
Available from the Clearinghouse as PB-188 047, $3.00 in paper copy, $0.65 in microfiche. 1969, 40 p. RRL-LR277.

Descriptors: *Drainage systems, Culverts, *Road construction.

The specification for British Standard gulley gratings, B.S.497, was revised in 1967. Measurements of the hydraulic efficiency of these gratings were made on a tilting platform which simulated a curbed road surface and which permitted the flow of water to the gulley to be varied by changes in the width of flow, the crossfall, and the longitudinal gradient. These efficiencies are given in the report. Consideration is also given to rainfall intensities and durations in the United Kingdom and a method for the design of spacing of gulleys is suggested based on the hydraulic efficiency of the gulleys and on tolerable widths of flow of water at the dege of the road.
W70-06457

LEVEE DISTRICTS (RECLAMATION PLANS).
Mo Ann Stat secs 245.140 thru 245.170 (1959).

Descriptors: *Missouri, *Land reclamation, *Levees, *Administrative agencies, Legal aspects, Legislation benefits, Damages, Planning, Assessments, Land appraisal, Construction, Embankments, Compensation, Costs, Right-of-way, Land tenure, Employment, Equipment, Specifications, Construction materials, Adjudication procedures.
Identifiers: *Levee districts.

The board of Supervisors of any levee district or owners of lands adjacent to such districts may petition the court organizing the district to correct any errors of incorporation and may petition for changes in the plan for reclamation. Where changes in the plan for reclamation are requested, the petition shall ask the court to either appoint three commissioners to appraise lands taken for the district, or assess benefits and damages to lands and changes in the reclamation plan. Procedures are outlined for court hearings on change petitions. Before a board may enter or appropriate any land for a levee district, damages as appraised shall be paid to the owner of the land. After payment, the title, use, possession, and enjoyment of such property shall be vested in the districts. Boards shall have full power and authority to build and complete all works which may be needed to carry out the plan for reclamation. Boards shall employ an attorney for the district, keep records of proceedings, and provide for compensation of employees and fees of officers. Standards of operation for boards are outlined. (Duss-Florida)
W70-06458

LEVEE DISTRICTS (ORGANIZED BY CIRCUIT COURT).

Mo Ann Stat secs 245.010 thru 245.025 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Levees, *Bank protection, *Wetlands, Dikes, Surface runoff, Flow control, Reclamation, Swamps, Overflow, Rivers, Streams, Legislation, Bank erosion, Land, Land tenure, Public health, Assessments, Taxes, Navigable waters, Federal government, Legal aspects, State governments, Cities, Erosion control.
Identifiers: *Levee districts.

The term 'levee district' refers to districts organized for the purposes of constructing levees, dikes, bank protections, current control or other protections contiguous or adjacent to lands which are subject to overflow and inundation. The lands must be wholly within or bordering the state of Missouri. Provisions outline the formation of districts in smaller cities and rural areas. 'Owner' means the owner of the freehold estate and excludes reversioners, remaindermen, trustees or mortgagees. The owners of a majority of acreage in any contiguous body of swamp, wet, or overflowed land, or land subject to overflow, wash or bank erosion, may form a levee district to protect such lands from these effects. Articles of association shall be filed with the clerk of the circuit court. If any work is to be done on a navigable stream, consent of the federal government must be obtained. The clerk of the circuit court shall give notice of the filing of articles by publication. Any owner within the proposed district may file objections which shall be heard by the court. Assessments and taxation provisions are included. (Duss-Florida)
W70-06468

HOKE V CITY OF GREENSBURG (MUNICIPAL LIABILITY FOR DIVERSION OF SURFACE WATER THROUGH STORM SEWER).

42 Westmoreland County Law Journal, Vol. 42, p. 225-229 (Pa Ct C P 1959).

Descriptors: *Pennsylvania, *Surface drainage, *Diversion, *Stormdrains, Sewers, Legal aspects, Judicial decisions, Channels, Damages, Drainage systems, Cities, Surface water, Conveyance structures, Reasonable use, Relative rights, Drainage effects, Water conveyance, Flooding, Artificial watercourses.

The defendant City of Greensburg installed a 14 inch storm sewer that extended along the westerly edge of a city street in a southerly direction. The storm sewer was then extended in a westerly direction to a 48 inch storm sewer which passed in a general southerly direction to real estate owned by plaintiffs. Plaintiffs filed a suit to recover for damages resulting to their property when defendant diverted surface water through the system onto plaintiffs' land. The jury returned a verdict for the plaintiffs and the defendants moved for a new trial. On appeal, the court held that the determination of defendant's liability was properly left to the jury. (Powell-Florida)
W70-06469

GIOVITTO V NASSAU COUNTY (OVERFL OF MUNICIPAL DRAINAGE SYSTEM).
63 NYS 2d 864-866 (1946).

Descriptors: *New York, *Drainage systems, * struction to flow, *Flood damage, Embankme Retaining walls, Surface runoff, Land use, Fl protection, Drains, Railroads, Local governme Legal aspects, Judicial decisions, Ditc Developed waters, Flood control, Damages, R tive rights, Discharge (Water).

Plaintiff brought action against Nassau county the Long Island Railroad Company for dama and injunctive relief to prevent further floodin his land. Defendant county had constructe drainage system which collected surface waters discharged them onto plaintiff's land. The c held that the county could not, by means of dit or drains, collect surface water into a single str and discharge it upon another's land. The railr whose large embankment caused water to back on one side, was not liable to plaintiff since a lo proprietor may protect his property from surf water even to the extent of throwing the water b upon the land of the adjoining proprietor. A lo proprietor must only refrain from collecting discharging the water upon adjoining premi (Hubener-Florida)
W70-06472

PERNELL V CITY OF HENDERSON (ACTI AGAINST MUNICIPALITY FOR THE REASONABLE DIVERSION OF WATER THE HARM OF RIPARIAN OWNERS).
220 N C 79, 16 SE2d 449-451 (NC 1941).

Descriptors: *North Carolina, *Riparian rig *Competing uses, *Reasonable use, Ripar waters, Cities, Alteration of flow, Dams, Re voirs, Diversion, Water management (Applic Natural flow doctrine, Prior appropriation, R tive rights, Streamflow, Water utilization, Div sion dams, Downstream, Water pollution, Le aspects, Judical decisions, Damages, Remedies.

Plaintiff alleged that defendant city's operation dam and reservior on the stream above his mill diverted the stream from its natural channel. T diversion was alleged to have diminished the va of plaintiff's mill site. Secondly, plaintiff sou damages for defendant's disposal of sewage into stream which had polluted such stream and crea a nuisance that caused injury to his business. fendant argued that as a municipality it had right to divert water for domestic purposes a riparian owner as long as the use was reasonab The court found the controlling rule to be tha political unit could not be a riparian owner and such claim the right to supply the needs of its habitants from the stream to the harm of an dividual downstream owner. The flow of water i stream is a natural property right of a ripar owner, the diversion of which is actionable damages. It was also held that the plaintiff co establish as actionable the injury which he sustained because of the maintenance of nuisance. (Barnett-Florida)
W70-06474

MULLINS V MORGAN (INJUNCTI AGAINST BUILDING WALL OUT INTO CHA NEL OF STREAM).
10 SE2d 593-598 (Va 1940).

Descriptors: *Virginia, *Barriers, *Obstruction flow, *Streams, Alteration of flow, Diversi Remedies, Structures, Floods, Abateme Damages, Legal aspects, Judicial decisions, Fl around objects, Deflection, Flow, Constructi Channels, Channel flow, Riparian land, Relati rights.

The plaintiffs sought an injunction against furth construction of a building which extended ou considerable distance into the channel of a cre and sought removal of a wall already construct

was evidence that the wall extended 11 feet
ito the channel, some one-seventh of the
el's width, and diverted the flow of water so
xpose plaintiffs to the danger of flood in time
n water. The court held that plaintiffs did not
to wait until damage actually occurred to
property, but could seek injunctive relief to
all injury. The wall constituted a private
ace, the court held, and could be abated by in-
on. The fact that plaintiffs had waited until
ll was finished before bringing the action was
ot to constitute laches barring relief, and a
court decision for the defendants was
ed. (Caldwell-Florida)
06491

S V CHICAGO, B AND O (LIABILITY NEGLIGENT CONSTRUCTION OF EM-KMENT).
W2d 617-635 (St. Louis Ct App Mo 1937).

riptors: *Missouri, *Flood damage, *Rail-
, *Natural streams, Embankments, Bridges,
low, Water spreading, Disasters, Levees,
aspects, Drainage districts, Water law,
rcourses (Legal), Intermittent streams, Chan-
Obstruction to flow, Rivers, Mississippi River,
ce waters, Tributaries, River flow, Rainfall.
ifiers: *Slough.

tiff brought action against the railroad com-
for flood damage to plaintiff's crops caused by
negligent construction of an embankment.
tiff claimed the embankment blocked the flow
ater in nearby watercourse thereby causing an
low onto plaintiff's land during a severe rain-
n. From a jury verdict for plaintiff, defendant
aled. The court of appeals held that the
ence was insufficient for submission to the jury
ne question of railroad's negligence. The court
d that the facts proved it impossible for the
ed up water to have destroyed plaintiff's crops.
court further found that a depression or slough
which the embankment was built was not a
ercourse.' A watercourse must have a definite
nel, defined banks and bed, and frequent,
gh not continued flow. Since there was no
rcourse, defendant was not liable for building
mbankment over a mere depression. In conclu-
the court stated that the plaintiff failed to show
usal connection between the alleged acts of
igence by the railroad and the damage to his
s. (Hubener-Florida)
0-06495

ESAPEAKE AND ORY V CAUDILL (FLOOD MAGES FROM ALLEGED NEGLIGENT NSTRUCTION AND REPAIR OF TRESTLE).

SW2d 20-25 (Ky 1937).

criptors: *Kentucky, *Damages, *Flood
nage, *Bridge construction, Judicial decisions,
ods, Bridges, Bridge design, Railroads, Repair-
Stream flow, Streams, Construction, Legal
ects, Structures, Flood waters, Flow, Obstruc-
to flow, Structural members, Alternation of
, Maintenance, Overflow.
ntifiers: *Temporary damages.

intiff alleged damage to his property caused by
am overflow resulting from defendant railroad
mpany's negligent construction and repair of its
stle. Damages were sought on the theory that
eless repair of the pilings had caused the stream
back up onto plaintiff's property. Defendant de-
d negligence, claiming that the trestle was a per-
nent structure rather than a temporary one thus
lucing the amount of possible recovery and al-
ing that the damage was caused by an extra-ordi-
y flood. In reversing an award for 'temporary
mages', the court held that any careless repair of
e trestle pilings was a temporary condition, and
t there was no evidence adduced supporting an
ard of damages for temporary conditions. All of
e plaintiff's proof had gone toward showing per-
nent damages. Where improper repair of a bridge causes a backup of floodwaters onto private property, the damages are temporary and recurring recoveries may be obtained. These recoveries must, however, be supported by proper proof, and cannot be satisfied by evidence of permanent damages. (Caldwell-Florida)
W70-06497

PRIVATE DRAINAGE RIGHTS.

Mo Ann Stat secs 244.010 thru 244.130 (1959).

Descriptors: *Missouri, *Surface drainage, *Relative rights, *Riddance (Legal aspects), Swamps, Judicial decisions, Land tenure, Drainage, Ditches, Levees, Construction, Wetlands, Bayous, Outlets, Costs damages, Benefits, Cost allocation, Compensation, Tile drains, Sanitary engineering, Agricultural engineering, Legislation, Legal aspects.

Owners of swamp, wet, flat, or overflowed lands may drain or protect such lands for sanitary or agricultural purposes by constructing ditches, tile drains, or levees. Such works may be constructed across intervening parcels of land in order to effect drainage into nearby waters. Compensation must be paid to owners of affected lands. This chapter outlines the relative rights of landowners before and after construction and sets forth the procedures for resolving disagreements over methods of drainage and construction. The circuit court shall have jurisdiction over such matters, shall entertain petitions for, and objections to, improvements and shall apportion the costs thereof. Appeal procedures are provided. Persons desiring to protect or drain land shall not be limited to a single ditch, tile, or levee. However, the benefits of the improvements must exceed any resultant damage. Persons interfering willfully with the usefulness of any ditch, tile or levee shall be guilty of a misdemeanor. Owners of land desired to be drained have the right to inspect, without the owner's consent, lands through which the improvements are to be built. (Duss-Florida)
W70-06505

McRAE V CAMDEN AND ROCKLAND WATER CO (ARTIFICIAL DRAINAGE ONTO ANOTHER'S LAND).
22 A 2d 133-135 (Me 1941).

Descriptors: *Maine, *Tile drainage, *Flood damage, Excess water, Tiles, Boundaries (Property), Controlled drainage, Drainage effects, Discharge (Water), Drainage systems, Drainage water, Seepage, Gravitational water, Subsurface drainage, Pipes, Flooding, Legal aspects, Judicial decisions, Relative rights, Damages.
Identifiers: *Prescription.

Defendant water company built and maintained a valve house over a surface water collection pit located drain on its own land. It built a 150 foot tile drainage pipe from the collection pit which emptied into a rock located on plaintiff's golf course. For unknown reasons the tile drain broke, and the break in the tile caused the rock drain to become stopped up. As a result, the water backed up and flooded large areas of plaintiff's fairways. The flooding continued even after defendant repaired the tile drain. Plaintiff brought action for damages. The court found no indication that defendant had a right through grant, prescription or otherwise to establish and maintain the tile drain on plaintiff's land. It held that no person may artificially collect water on his own land and discharge it on his neighbor's property upon which it would not have naturally fallen. If he does so, he is liable for the resulting damages. (Clarke-Florida)
W70-06506

GEOHYDROLOGY OF THE CROSS-FLORIDA BARGE CANAL AREA WITH SPECIAL REFERENCE TO THE OCALA VICINITY,
Geological Survey, Tallahassee, Fla.
Glen L. Faulkner.
Geological Survey Open-file Report, January 1970. 222 p, 35 fig, 3 tab, 66 ref.

Descriptors: *Hydrogeology, *Florida, *Canals, *Canal seepage, Transportation, Water pollution sources, Groundwater movement, Canal design, Springs, Aquifers, Limestones, Karst, Water supply.
Identifiers: Cross-Florida Barge Canal.

The Cross-Florida Barge Canal route commences at Palatka on the St. Johns River, and extends across Peninsular Florida into the Gulf of Mexico near Yankeetown. From near Ocala northeastward, the canal channel will replace much of the natural channel of the Oklawaha River, and will be excavated into the shallow sand aquifer of Miocene and younger age, which overlies limestone of the Floridan aquifer. Westward from Ocala most of the canal will be excavated below the potentiometric surface into limestone and dolomite of the Floridan aquifer. Only principal rivers, such as the Oklawaha and Withlacoochee Rivers, and a few short tributaries flow, while one of the most highly developed subsurface drainage systems in the world has evolved in the cavernous limestones of the Floridan aquifer. Two of the larger fresh-water springs in the world now discharge from the Floridan aquifer in the canal area. The greatest potential for adverse effects on the ground-water regime exists in the area of the Summit Pool. The canal channel will be excavated into limestone of the Floridan aquifer to depths of 12 to 27 feet below the potentiometric surface. It is particularly important in the Summit Pool to use good construction and operation, to minimize risks of groundwater contamination. (Knapp-USGS)
W70-06534

A DAM ACROSS THE AMAZON,
Hudson Inst., Inc., Croton-on-Hudson, N.Y.
Robert B. Panero.
Science Journal, Vol 5A, No 3, p 56-60, September 1969. 5 p, 2 fig, 1 photo, 3 ref.

Descriptors: *Dams, *Reservoirs, *Planning, *Water resources development, *Feasibility studies, Multiple-purpose projects, Project planning.
Identifiers: Amazon River.

A dam is proposed for the Amazon River. An inland Amazon Sea connected to a network of Great Lakes could be created by damming the Amazon and its tributaries. The project would open up a development area the size of the United States and provide unprecedented quantities of hydroelectricity. If damming the Amazon mainstream is possible it should be in the area between Monte Alegre and Obidos where the natural narrows occurs. The dam would be relatively easy to build for three specific reasons: the foundation is essentially compacted sand and gravel; there is no record of earthquakes in the zone; and all required construction materials are available in the vicinity. The cost of such a dam, 25 m high and 65 km long, is about $800 million. (Knapp-USGS)
W70-06538

MALVERN GRAVEL CO V McMILLAN (WHETHER OPERATIONS OF UPSTREAM GRAVEL COMPANY CAUSED DIVERSION OF FLOOD WATERS ONTO PLAINTIFF'S PROPERTY).

139 SW2d 390-394 (Ark 1940).

Descriptors: *Arkansas, *Obstruction to flow, *Natural flow doctrine, *Flood damage, Damages, Diversion, Reasonable use, Remedies, Judicial decisions, Land use, Riparian rights, Floods, Overflow, Floodwaters, Levees, Canals, Channel flow, Rivers, Sedimentation, Structures, Alteration of flow, Relative rights, Legal aspects, Banks, Gravels.

Plaintiff landowner claimed that defendant's upstream gravel mining operations, which allegedly damaged levees and embankments, diverted flood-

waters onto plaintiff's land. Gravel was also allegedly washed onto the land causing extensive damage. The court agreed that a riparian owner is entitled to have the stream flow in its natural and customary course without obstruction, and that any diversion causing injury is actionable. No evidence was found, however, which showed any damage to banks or levees beyond that left by an earlier flood in 1927. The evidence pointed to the fact that any lowering of the bank level, which contributed to the flooding of plaintiff's land, was due to the earlier flood damage and not to defendants' operations. (Caldwell-Florida)
W70-06541

FLOOD PLAIN INFORMATION, LITTLE TIMBER CREEK, CAMDEN COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

Prepared for Camden County Planning Board and N J Dept of Conserv and Econ Development Corps Engineers Flood Plain Report, March 1969. 49 p, 3 fig, 11 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Camden County (NJ), Standard project flood, Intermediate regional flood.

Flooding of Little Timber Creek, Camden County, New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06543

POSSIBILITIES OF BIOLOGICAL CONTROL OF AQUATIC WEEDS IN INDIA.
Commonwealth Inst. of Biological Control, Bangalore (India).

Water Resources Journal, United Nations Economic Commission for Asia and the Far East (ECAFE), p 40-50, September 1969. 11 p, 29 ref.

Descriptors: *Aquatic weeds, *Biocontrol, Integrated control measures, Water resources development
Identifiers: *India.

A large number of aquatic weeds occur in Indian inland waters, including lakes, tanks, ponds, irrigation channels and cultivated areas temporarily covered by water, such as rice and jute fields. Their harmful nature is due to the fact that they may pollute drinking water when they die and decay, provide convenient breeding sites for mosquitoes and, by invading large areas and occurring in dense stands, impede the free movement and use of water in irrigation systems and interfere with fish culture and growing crops, such as rice and jute. In most parts of India mechanical control measures are adopted where they are absolutely necessary, as in the case of irrigation channels, and large sums of money are spent annually for this purpose. There is very little money available for chemical control of aquatic weeds. Therefore, aquatic weed control in India may well be attempted by non-chemical methods, such as mechanical and biological methods. Though farmers may be interested in their control they would be unable or unwilling to pay for it. During the last few years, the Indian station of the Commonwealth Institute of Biological Control has been conducting a survey for natural enemies of several major and minor aquatic weeds. As a result of this survey a number of insects, fungi and other organisms associated with these weeds have been recorded, host-specificity tests conducted and their actual or potential value as biocontrol agents evaluated. (Knapp-USGS)
W70-06549

FLOOD PLAIN INFORMATION, DEKALB COUNTY, GEORGIA.
Corps of Engineers, Savannah, Ga.

Prepared for DeKalb County, Georgia. Corps Engineers Flood Plain Report, October 1968. 73 p, 39 fig, 66 plate, 18 tab.

Descriptors: *Floods, *Flood damage, *Georgia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: DeKalb County (Ga), Standard project flood, Intermediate regional flood.

Flooding of DeKalb County (Georgia) is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06568

RUTKA V RZEGOCKI (ALTERATION OF FLOW AND OBSTRUCTION CAUSED BY WALL CONSTRUCTION).
43 A 2d 658-659 (Conn 1945).

Descriptors: *Connecticut, *Flooding, *Walls, *Alteration of flow, Land use, Boundaries (Property), Discharge (Water), Legal aspects, Land development, Embankments, Slopes, Natural flow, Surface waters, Repulsion (Legal aspects), Relative rights, Obstruction to flow, Surface runoff, Judicial decisions.

Plaintiff claimed that defendant, in building a wall along their common boundary line, had affected the slope of the land so as to cause surface waters to discharge and collect on plaintiff's land. The court stated as a general rule that a landowner must not use or improve his property in such a way as to increase the total volume, or alter the natural flow, of surface water which flows onto adjoining property. Conflicting evidence had been presented as to whether the wall, together with an embankment and other changes on defendant's land, had the effect of discharging water onto plaintiff's property in a manner different in volume and course from its natural flow. The trial court's decision that plaintiff had failed to show an alteration of flow by a preponderance of the evidence was affirmed. (Caldwell-Florida)
W70-06603

ROBERTSON V ARNOLD (DIVERSION OF TRIBUTARY WATERS RESULTING IN STREAM DRAWDOWN).
186 SE 806-810 (Ga 1936).

Descriptors: *Georgia, *Riparian rights, *Tributaries, *Diversion losses, Flow, Diversion, Judicial decisions, Legal aspects, Land tenure, Riparian land, Soils, Non-navigable waters, Springs, Streams, Bodies of water, Water loss, Water supply, Watercourses, Ditches, Mills, Powerplants, Alteration of flow, Remedies, Relative rights, Drawdown.

Plaintiff was a lower riparian owner. Defendant was an upper riparian owner. Defendant diverted water from one of the tributaries feeding a non-navigable stream on plaintiff's land, and planned to divert water from another tributary. Plaintiff sought to enjoin defendant, alleging that the diversion diminished the value of his property because reduced the flow over a water race constructed the property. This water race made the plaintiff land adaptable for construction of a mill or pow plant, though neither had ever been built. The t court sustained a demurrer to the petition beca it found it too speculative. The Georgia Supre Court reversed, holding that according to law owner of land through which non-navigable wa courses may flow is entitled to have the water co to the land in its natural and usual flow. Runn water belongs to the owner of the land while it is the land, but there is no power to divert it from usual channel, nor interfere with the enjoymen the next owner. (Duss-Florida)
W70-06653

CITY OF LOUISVILLE V TWAY (LOW RIPARIAN OWNER CONTESTING DA ACROSS STREAM AND POLLUTION UPPER RIPARIANS).
180 SW2d 278-281 (Ky 1944).

Descriptors: *Kentucky, *Natural flow doctr *Reasonable use, *Riparian rights, Dams, Obstr tion to flow, Judicial decisions, Streams, Nat watercourses, Watercourses (Legal), Diversi Reservoirs, Riparian land, Water pollution sour Pollution abatement, Dairy industry, Rela rights, Land use, Dam construction, Drain water, Manure, Remedies, Cities.

Defendants were upper riparian landowners wh property was traversed by the same stream. defendant, a dairy farmer, permitted wastes fr the dairy floor and manure to enter the stream had also constructed a large concrete dam wh allegedly impeded streamflow. The other de dant had built a series of small dams to create po in the stream and had also constructed a reser to capture flow from a spring to the stream. Pl tiffs, a lower riparian owner and the city Louisville, sued to halt the pollution and the in ference with the natural stream flow. The d farmer agreed to submit to an injunction orde the abatement of the pollution. The other de dant agreed to remove the series of dams wh created the pools. With regard to the la concrete dam and the reservoir, the appellate co affirmed the lower court's finding that there not in either instance an unreasonable use of w since no water was utilized from these sources. court also affirmed the finding that these structu caused no appreciable decline in the flow of w in the stream. (Dearing-Florida)
W70-06664

JOHNSON V LAINHART (CONSTRUCTION BARRIERS TO RESTORE LAND LO THROUGH ACCRETION).
118 SW2d 204-208 (Ky 1938).

Descriptors: *Kentucky, *Accretion (L aspects), *Boundaries (Property), *Alteration flow, Channels, Streams, Walls, Obstruction flow, Channel flow, Riparian rights, Riparian la Legal aspects, Judicial decisions, Bank eros Non-navigable waters, Bank erosion, Barri Boundary disputes, Streamflow, Banks, Remed Floods, Bank protection, Erosion control.

The channel of a non-navigable stream forming boundary between plaintiff's and defendant's p perty had gradually shifted, extending by accre plaintiff's property and causing a correspon loss of defendant's land. The plaintiff sough prevent defendant from building a wall in streambed which would alter the flow of the str so as to restore it to its old channel. The court that defendant's stream boundary had chan with the shifting of the channel and that he had right to attempt to restore the former chan Although conceding that the rule was other where the channel was changed rapidly, as flood, the court found that such rule was not plicable in the instant case and enjoined defen from building the wall out into the stream.

stated that defendant was entitled to build a long the present banks to protect his property further erosion, but that he could not attempt n back property which no longer belonged to by restoring the old channel. (Caldwell-la)
06675

ER STORAGE,
ultural Research Service, Logan, Utah. Soil Water Conservation Research Div.; and Utah ultural Experiment Station, Logan.
rimary bibliographic entry see Field 03B.
06680

LONG DRINK: WATER CONVEYANCE IN URAL AND ARTIFICIAL CHANNELS,
rimary bibliographic entry see Field 03B.
06681

SAPEAKE AND O RY V SAULSBERRY LIGENT FLOODING OF RIPARIAN DS).
W2d 949-951 (Ky 1935).

riptors: *Kentucky, *Railroads, *Obstruction ow, *Bridges, Legal aspects, Riparian rights, ral flow doctrine, Proprietary power, Relative s, Riparian land, Watercourses (Legal), nage, Floods, Streamflow, Judicial decisions, tments, Culverts, Streams, Streamflow.

ndant railroad had constructed a bridge over a k. Over a period of time, sediment and other is collected in the aperture under the bridge to extent that during a period of heavy rains, the len creek was prevented from flowing freely ugh the aperture. This caused plaintiff's adjoin-land to be flooded by the overflow. Plaintiff ht damages for defendant's negligence in fail-o maintain an opening under its bridge suffi-tly large to allow free passage of water from y rains. The court held that a lower proprietor t required to immediately remove from a chan-debris which collects around an intruding struc-, but he must do so within a reasonable time. ewise, such a proprietor has a continuing duty xercise reasonable care in maintaining openings eath his bridges and cluverts sufficient to allow passage of water during normal heavy rains. endant breached this duty and was liable to ntiff for damages. (Clarke-Florida)
0-06712

CORSON V CAMDEN (HIGHWAY IM-OVEMENT ALLEGED TO INTERFERE TH DRAINAGE).
NW2d 407-411 (Iowa 1945).

criptors: *Iowa, *Drainage, *Highways, *Natu-flow, Ditches, Surface waters, Diversion, Ob-ction to flow, Drainage water, Surface runoff, inage effects, Drainage engineering, Land ure, Legal aspects, Relative rights, Damages, nedies, Maps, Flood damage, COnstruction, scriptive rights, Culverts, Judicial decisions, ps.

intiff's land, which was separated from defen-t's property by a road, drained naturally onto endant's land. Plaintiff alleged that work done the road, and defendant's filling in of a culvert, tructed this natural drainage, caused water to k up on plaintiff's property, and caused crop nage. The court, relying on survey plats sented by plaintiff's engineer, found that the ural dramage was as alleged. The court also held t the work done on the road had obstructed the inage in that a ditch on the side of the road per-tted water to flow along the road and collect in a r point on plaintiff's property rather than con-uing its natural flow onto defendant's land. The ing in of the culvert by the defendant was also ongful. The highway authority was held to be under a duty to permit surface water to drain in its natural manner. An injunction was held to be appropriate to restrain highway officials and defendant from causing water to flow upon plaintiff's land in an unnatural manner. (Caldwell-Florida)
W70-06713

PEOPLE V RIX (COST SHARING BETWEEN STATE AND LOCAL GOVERNMENTS).
169 NW2d 132-134 (Ct App Mich 1969).

Descriptors: *Michigan, *Drains, *Cost allocation, *Administrative agencies, Administration, Regulation, Drainage systems, Judicial decisions, Legal aspects, Waste water disposal, State governments, Highways, Local governments, Equitable apportionment, Public health, Rates, Costs, Cost sharing Assessments, Drainage.

Pursuant to a state statute, a drainage board was created in Kalamazoo County. A drain was deemed necessary, and the board determined that the State Highway Commission's share of the cost of such drain was twenty percent of such cost. On appeal to the circuit court, the board's decision was affirmed. The Commission appealed, asserting that twenty percent drain assessment was arbitarary and capricious in disregard of the law and facts, and in excess of the board's jurisdiction. The appellate court affirmed stating that the administrative decision as to the amount of the assessment was not judicially reviewable unless there was evidence of fraud or bad faith present. Upon a complete hearing it was found that the board's actions fully complied with the statute and that the return made by the drain board showed a satisfactory basis for the determination made. (Barnett-Florida)
W70-06717

DUNLAP V CAROLINA POWER AND LIGHT CO (ACTION FOR DAMAGES TO ENJOIN UNREASONABLE USE OF RIPARIAN WATERS).
212 N C 814, 195 SE 43-49 (N C 1938).

Descriptors: *North Carolina, *Reasonable use, *Alteration of flow, *Dams, Competing uses, Diversion, Electric power, Natural flow doctrine, Obstruction to flow, Prior appropriation, Relative rights, Water pollution, Riparian rights, Riparian land, Riparian waters, Remedies, Legal aspects, Judicial decisions, Erosion, Banks, Streams, Rivers, Water levels.

Plaintiff owned riparian land on a non-navigable river. Defendant constructed a dam across the river upstream from plaintiff's land. Plaintiff alleged that the impounding and releasing of waters in defendant's dam operations interfered with his reasonable use of the water as a riparian landowner. The appellate court held that a riparian owner has the right to the reasonable use of the river as long as he does not pollute or divert it so as to deprive others of their riparian rights. There may be such diminution and retardation of the natural flow as is necessary to allow beneficial and reasonable use of the waters. The right to use necessarily implies a right to exercise a degree of control over the water, and to some extent, to diminish its volume. Such interruption of streamflow as is necessary and unavoidable cannot be the subject of an action. (Barnett-Florida)
W70-06718

BRUTON V CAROLINA POWER AND LIGHT CO (JUDGMENT FOR PERMANENT DAMAGES CAUSED BY DAM-CREATED FLOODING AS BAR TO SUBSEQUENT ACTION).
217 N C 1, 6 SE2d 822-830 (N C 1940).

Descriptors: *North Carolina, *Damages, *Flood damage, *Easements, Judicial decisions, Obstruction to flow, Floods, Legal aspects, Land tenure, Land use, Riparian land, Riparian rights, Condemnation, Eminent domain, Flow, Overflow, Erosion, Rainfall, Precipitation excess, Floodgates, Dams, Construction, Structures, Hydroelectric power.

Plaintiffs, lower riparian owners, brought suit against the defendant, an upper riparian owner, for floodwater damages to their property resulting from the negligent operation of defendant's hydroelectric dam. Plaintiff's testator during his lifetime had brought suit and recovered from defendant in two related actions--one for damages to agricultural crops from flooding, and one for permanent damages to his ferry operation due to defendant's obstruction to flow. In this action defendant interposed a plea of res judicata and moved for nonsuit. The trial court eventually granted this motion. The North Carolina Supreme Court affirmed. The wrong complained of by plaintiffs' testator (in one of his actions) was continuing in nature, resulting from construction and maintenance of a permanent power plant. The assessment and payment of permanent damages vested in the defendant an easement entitling him to continued use of the property in the existing manner. (Duss-Florida)
W70-06719

MITCHELL V VIRGINIA RR (ACTION FOR DAMAGES RESULTING FROM THE OBSTRUCTION OF A STREAM BY A RAILROAD BRIDGE).
183 SE 35-39 (W Va 1935).

Descriptors: *West Virginia, *Floods, *Watercourses (Legal), *Obstruction to flow, Judicial decisions, Legal aspects, Overflow, Floodwater, Flow, Railroads, Bridges, Culverts, Construction, Maintenance, Bodies of water, Streams, Rain, Riparian land, Riparian rights, Land, Land tenure.

Plaintiffs were owners of property located upstream from defendant railroad's bridge over the stream. Plaintiffs alleged, that because of insufficient clearance between the bridge and the water, timber and debris lodged against the bridge causing water to back up onto plaintiffs' property. Defendant claimed that the bridge had sufficient clearance to accommodate floodwaters that could have reasonably been anticipated, and that the floods which cuased the damage constituted 'an act of God.' From a judgement for plaintiff defendant appealed. The Supreme Court of Appeals of West Virginia affirmed, holding that it is the province of the jury to determine whether a flood is so extraordinary as to amount to an act of God. One obstructing a natural watercourse will not be excused from liability for resulting damage unless an act of God is the sole and proximate cause of the injury. Prior evidence of flooding was an important consideration in the case, and the court felt that such evidence was sufficient to support the issue of reasonable anticipation of future floods. (Duss-Florida)
W70-06720

FARRINGTON V KLAUBER (RIGHTS OF ADJOINING RIPARIAN OWNERS TO UNOBSTRUCTED FLOW).
32 A2d 644-646 (Conn 1943).

Descriptors: *Connecticut, *Dams, *Overflow, *Flow control, Obstruction to flow, Legal aspects, Riparian rights, Judicial decisions, Relative rights, Natural flow, Dam construction, Ponding, Banks, Streamflow, Water control, Watercourses (Legal), Natural flow, Spillways, Concrete structures, Legal aspects, Barriers.
Identifiers: Injunctions (Mandatory).

The defendant erected a dam across a small watercourse that flowed on his land. The plaintiff sought an injunction for the removal of the dam to restore former water level, claiming that the dam caused water to overflow on his land. The trial court found that at no time had the defendant's acts substantially raised the water level on the plaintiff's land and denied an injunction. The appellate court acknowledged the right of an adjoining landowner

to require the water to flow in the accustomed manner, but reasoned that where there is no substantial invasion of plaintiff's rights, the issuance of an injunction rests in the discretion of the trial court. (Hubener-Florida)
W70-06722

GREENWOOD V EVERGREEN MINES CO (OBSTRUCTION OF NATURAL FLOW BY MUNICIPALITY).

19 NW2d 726-735 (Minn 1945).

Descriptors: *Minnesota, *Artificial watercourses, *Flood damage, *Obstruction to flow, Lakes, Water levels, High water mark, Riparian land, Natural flow, Damages, Judicial decisions, Cities, Diversion, Alteration of flow, Legislation, Culverts, Surface waters, Riparian rights, Natural flow doctrine, Drains, Outlets, Legal aspects, Floods, Barriers, Administrative agencies.

The principal defendant, a municipality, had closed the naturaloutlet of a lake and installed culverts to carry away excess lake water. Over the years, the culverts became obstructed and during times of heavy rainfall the plaintiff's lakefront property was flooded, causing damage. The court held that plaintiffs were entitled to have the lake level remain at its natural high water mark, and that a municipality would be liable just as would a private defendant for obstructing the natural flow. While the defendant had statutory authority to close the natural outlet, it was under a duty to do so in a manner which would not damage lake front property. Defendant claimed, and the trial court found that as the state highway department had taken over the road under which most of the culverts ran, the defendant municipality had not breached any affirmative duty and that the highway department was negligent. However, the court held tha t the defendant had the means to clear the obstruction and in fact had eventually clared it. The municipality was thus held to be actively negligent, and the trial court decision was reversed. (Caldwell-Florida)
W70-06730

SWEIGART V BURKHOLDER (RIGHT TO DIVERT SURFACE WATERS ONTO ADJOINING LAND).
154 Pa Super 505, 36 A 2d 181-183 (1944).

Descriptors: *Pennsylvania, *Surface waters, *Natural flow, *Diversion, Ditches, Judicial decisions, Relative rights, Legal aspects, Barriers, Embankments, Retaining walls, Damages, Surface drainage, Surface runoff, Repulsion (Legal aspects), Riddance (Legal aspects), Natural flow doctrine, Natural streams.
Identifiers: *Dominant estate.

Plaintiff brought suit to enjoin defendants from diverting natural surface water over plaintiff's land by the erection of artificial barriers and embankments. Before the erection of the barriers, the natural flow of water over plaintiff's land was carried by a ditch separating defendants' and plaintiff's land. Defendants contended that the erection of the barriers was necessary to protect their property since plaintiff had first erected barriers on his land which unlawfully directed surface water onto defendants' land. The trial court found that the water running over defendants' land was limited to the natural flow of surface water and defendants were not entitled to divert its natural flow over the dominant estate of plaintiff. The court of appeals affirmed the judgement, stating that the owner of a dominant estate has an easement in a servient estate for the discharge of all waters which by nature rise in, flow or fall upon the dominant estate. (Huebner-Florida)
W70-06731

4B. Groundwater Management

GROUND-WATER CONDITIONS DURING 1968, VANDENBERG AIR FORCE BASE AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
J. H. Koehler.
Geological Survey Open-file Report, February 6, 1970. 20 p, 7 fig, 3 tab, 4 ref.

Descriptors: *Water levels, *Groundwater, *Water supply, *California, Water utilization, Water wells, Withdrawal, Aquifers, Water quality, Drawdown, Manganese, Water yield, Water storage.
Identifiers: Vandenberg Air Force Base (Calif).

The water supply for Vandenberg Air Force Base is obtained from supply wells in Lompoc terrace, Lompoc plain, and San Antonio Valley. About 5,790 acre-feet of water was pumped during calendar year 1968. Between November 1967 and November 1968 the average water-level decline in Lompoc terrace was 0.2 foot; in Lompoc plain, about 1.8 feet; and in the San Antonio Valley area, about 0.5 foot. The water level in the supply wells in San Antonio Valley did not decline in 1968. The decline in water levels indicates a decrease in groundwater in storage. Because of the high dissolved-solids content in the water in the Lompoc plain and Lompoc terrace areas, new domestic supply wells, when needed, should be drilled in the San Antonio Valley area. The fluoride concentration in the base supply wells is less than the lower limit recommended by the U.S. Public Health Service. A trace element analysis indicates a manganese concentration of about four times the recommended upper limit. (Knapp-USGS)
W70-06321

GEOLOGY AND GROUNDWATER RESOURCES OF GRAND FORKS COUNTY, NORTH DAKOTA, PART 3-GROUNDWATER RESOURCES,
Geological Survey, Bismarck, N. Dak.
For primary bibliographic entry see Field 02F.
W70-06337

GEOLOGY FOR PLANNING IN DE KALB COUNTY, ILLINOIS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 02F.
W70-06338

AVAILABILITY OF WATER FOR ARTIFICIAL RECHARGE, PLAINS GROUNDWATER MANAGEMENT DISTRICT, COLORADO,
Geological Survey, Denver, Col.
C. T. Jenkins, and W. E. Hofstra.
Colorado Water Conservation Board Groundwater Series Circular No 13, 1970. 16 p, 6 fig, 3 tab, 5 ref.

Descriptors: *Water sources, *Surface waters, *Artificial recharge, *Colorado, Aquifers, Alluvium, Streamflow, Reservoir design, Precipitation (Atmospheric), Runoff, Evapotranspiration.
Identifiers: Ogallala Formation.

The Plains Groundwater Management District (Colorado) and the U.S. Geological Survey began a cooperative study in March 1969 to investigate the availability and distribution of surface water for artificial recharge to the Ogallala aquifer. The mean annual surface runoff out of the Plains District is estimated to be about 12,000 acre-ft per year, compared to groundwater withdrawals of about 142,000 acre-ft (1968). The surface runoff amounts to about 0.13 inch per year of a total of 16 inches of precipitation. If impounding structures were located in or upgradient from the groundwater withdrawal area, the amount of water available would be less than that available at the boundaries of the District. Extensive recharge operations therefore may not be feasible. Water in some of the stream channels contributes substantial recharge to the aquifer under present conditions. Runoff from about 20% of the area of the District is caught playas and does not contribute to surface run out of the District. Some of this water recharges aquifer but most of it is lost by evaporation. A s nificant amount of water probably could salvaged by pumping water from playas or tailwa ponds into irrigation systems. (Knapp-USGS)
W70-06339

GEOLOGY AND GROUNDWAT RESOURCES OF WELLS COUNTY, NOR DAKOTA: PART III - GROUNDWAT RESOURCES,
Geological Survey, Bismarck, N. Dak.
For primary bibliographic entry see Field 02F.
W70-06340

GEOLOGY AND RELATED GROUNDWAT OCCURRENCE, SOUTHEASTERN MAS COUNTY, WASHINGTON,
Department of Water Resources, Olym Washington.
For primary bibliographic entry see Field 02F.
W70-06341

THE YORK COUNTY GROUNDWAT WITHDRAWAL INVESTIGATION, 1968,
Nebraska Univ., Lincoln. Dept. of Agricultural gineering.
Deon Axthelm, and Ismet Bozkurt.
Nebraska Univ Agricultural Engineering Rep No. 1, August 1969. 6 p, 1 tab, 3 append.

Descriptors: *Water levels, *Groundwa *Withdrawal, *Irrigation water, *Nebraska, S veys, Water level fluctuations, Data collectio Hydrologic data, Water utilization, Recha Precipitation (Atmospheric), Water balance.
Identifiers: *York County (Nebr).

Irrigation withdrawals of groundwater were de mined in York County, Nebraska, in 1968. Th were 149 registered wells in York County in 19 The number increased to about 1,580 in the fal 1968--almost 10 times more wells in 20 years. the average, 70 wells were added per year. H ever, during the dry period of 1955 to 1957, th was a great increase in the annual number of w installed; over 300 in 1956. Although the inc ment has begun to decrease in recent years, it is pected that the construction of new and lar capacity wells will continue. The average of values calculated by operator records and by po consumption shows 97,686 acre-feet of wa withdrawal for 1968. The climatological data fr the U.S. Weather Bureau Stations at Gresh Bradshaw, McCool Junction, Utica, and York sh an average of 28.11 inches of precipitation for year 1967 compared to 38.88 inches which fel 1968 or a ratio of 1.4 times more. The irrigat season for both years was primarily in July and A gust. The records show that there was about tw as much rainfall in 1968 during the irrigat season than in 1967. In contrast to previous reco the groundwater levels increased on the aver about +0.22 feet from June 1968 to June 19 Although there was a net positive change, wa table levels in some areas were lower and in so locations they were considerably higher. (Kna USGS)
W70-06360

WATER WELLS AND SPRINGS IN PANAMI SEARLES, AND KNOB VALLEYS, S BERNADINO AND INYO COUNTI CALIFORNIA,
Geological Survey, Menlo Park, Calif.
W. R. Moyle, Jr.
Copies of report available for sale from State California, Office of Procurement, Documents S tion, P. O. Box 20191, Sacramento, Calif 958 Price $2.00. California Department of Wa Resources Bulletin No 91-17, December 1969. p, 5 tab, 33 map, 12 ref.

ptors: *Water wells, *Springs, *California, dwater, Water yield, Water utilization, levels, Water level fluctuations, Drawdown, ic capacity, Geology, Hydrogeology, logic data, Data collections.
iers: Panamint Valley (Calif), Searles Valley), Knob Valley (Calif).

wells and springs in Panamint, Searles, and Valleys, California were surveyed as part of a on water wells and springs in southern rnia desert areas. The series is prepared by S. Geological Survey and published by the rnia Department of Water Resources. Each n locates water wells and springs in a part of outhern California desert region; describes epth and yield, water use and level on dates ved; names the well owner; provides pumping including depths, rates, static water levels, lowns, and specific capacities; and includes gic data from drillers' well logs. (Knapp-)
06363

HRAUFF V SINKING SPRING WATER CO EFICIAL USE OF GROUNDWATER AND OINING LANDOWNER'S RIGHTS).

2d 87-92 (Penn 1940).

riptors: *Pennsylvania, *Supply contracts, er contracts, *Water supply, Water shortage, r demand, Water requirements, Legal aspects, ndwater, Groundwater mining, Springs, Inter- transfer, Adjudication procedure, Judicial ions, Natural flow doctrine, Relative rights, r rights, Usufructuary right.

ndant water company contracted with plain- o purchase, for sale to the public, the effluent a spring on plaintiff's land. In oreder to aug- its water supply, defendant contracted with tiff at the same price to sink a well on the same . The well increased the total water supply but eased the output of the spring. Requiring a still r supply, defendant purchased land adjoining tiffs' and drilled another well thereon which uced water but caused plaintiff's spring to dry The well on plaintiff's property continued to p, however, and plaintiffs were paid according he contract. Plaintiffs sought damages for ch of the first spring contract on the theory the prevention by a party to a contract of per- ance by the other party constitutes a breach of contract. The court held that when a spring ch depends on percolations through the land of djoining owner is destroyed through use for a ful purpose', absent malice or negligence, such er is not liable for damages caused thereby. court found the better American view to be the phrase 'lawful purpose' contemplated a use ted to the beneficial enjoyment of the land, and a diversion or sale to others, which impaired supply of water on the property of another, was a use for a 'lawful purpose.' In drilling the nd well, defendant prevented plaintiffs from forming the contract and were liable for the ach thereof. The measure of damages, however, limited to the contract price, multiplied by the uced output of the spring after the first well was led, for the life of the contract. (Clarke-Florida)
0-06397

OUNDWATER SUPPLY OF CAPE HAT- RAS NATIONAL SEASHORE RECREA- ONAL AREA, NORTH CAROLINA - PART 6,
ological Survey, Raleigh, N.C.
ille B. Lloyd, Jr. and Roberta B. Dean.
rth Carolina Department of Water Resources port of Investigations No 7, 1968.

scriptors: *Water supply, *Camp sites, *Na- nal seashores, *North Carolina, *Groundwater, ater wells, Aquifers, Saline water intrusion, Safe ld, Sands, Silts, Saline water, Infiltration, charge.
ntifiers: Cape Hatteras National Seashore.

Pea Island Campground, part of Cape Hatteras National Seashore Recreational Area, is at the northern end of Hatteras Island. A groundwater investigation at the campground site was made to determine the thickness, extent, and lithic character of the water-bearing formations and the movement, quantity, and chemical quality of the groundwater. Three sand aquifers separated by silt underlie the Pea Island Campground area to depths of about 60 feet. The medium-grained sand unit between approximately 9 and 24 ft below mean sea level is the most desirable water-bearing zone for developing future groundwater supplies, because it contains the largest amount of water of good quality in the area. Upward leakage of saline groundwater occurs after more than a 0.5 ft head differential is established. (Knapp-USGS)
W70-06399

MILLERS RIVER BASIN, MASSACHUSETTS BASIC-DATA REPORT NO.11-GROUND-WATER SERIES,
Geological Survey, Boston, Mass.
Donald R. Wiesnet, and William B. Fleck.
Geological Survey Open-file Report, 1967. 29 p, 1 fig, 1 plate, 9 tab.

Descriptors: *Groundwater, *Water wells, *Data collections, *Hydrologic data, *Massachusetts, Water wells, Aquifers, Water yield, Water quality, Water levels, Hydrographs, Maps.
Identifiers: Millers River basin (Mass).

This report presents, in tabulated form, much of the groundwater basic data collected in the Massachusetts portion of the Millers River basin during a comprehensive study of water resources. Tabulated data include geologic units, well records, well logs, test-hole logs, chemical analyses, watersupply system data, and a list of water reports available for Maine, Massachusetts, and New Hampshire. Hydrographs show monthly water levels in observation wells. (Knapp-USGS)
W70-06405

SHICK V DEARMORE (RIGHTS TO WATER WELL).

442 SW2d 198-201 (Ark 1969).

Descriptors: *Arkansas, *Well casings, *Water wells, *Contracts, Judicial decisions, Legal aspects, Water sources, Water supply, Drilling, Steel pipes, Well spacing, Drilling equipment, Potable water, Negotiations, Third party effects, Boundaries (Property), Consumptive use, Relative rights.

Plaintiff property owner brought suit to enjoin defendant well-driller from removing a water well or from claiming a well-driller's lien on a well mistakenly drilled on plaintiff's property. Defendant counter-claimed for the contract price of the well. The trial court held for plaintiff and defendant appealed. Plaintiff had sold land to a third party who contracted with defendant to drill a water well. The third party abandoned the land and the contract with defendant. The well was mistakenly drilled on plaintiff's land. The lower court ruled for plaintiff adhering to the common-law rule that a permanent improvement that was placed upon another's land by mistake becomes part of the realty. The question on appeal was whether defendant was entitled to remove the casing that he installed on plaintiff's land. The appellate court exercised its equitable jurisdiction and deviated from the common-law rule. The court found that to refuse to allow the removal of the casing would be to unjustly enrich the plaintiff to the extent of the value of the well. The case was reversed and remanded. (Barnett-Florida)
W70-06486

CITY OF ATLANTA V HUDGINS (ACTION BY PROPERTY OWNER AGAINST THE MUNICIPALITY FOR UNLAWFUL DIVERSION OF WATERS).
19 SE2d 508-516 (Ga 1942).

Descriptors: *Georgia, *Water wells, *Water rights, *Beneficial use, Lakes, Cities, Reasonable use, Alteration of flow, Groundwater, Judicial decisions, Legal aspects, Non-navigable waters, Remedies, Riparian rights, Natural flow doctrine, Relative rights, Right-of-way, Sewers, Disposal, Subsurface drainage, Eminent domain, Damages, Diversion, Water pollution.

Plaintiff owned a tract of land on which was situated water wells and a lake fed by a stream emanating from nearby springs. Defendant condemned a right-of-way across the land for the purpose of constructing a trunk sewer to service the metropolitan area. Plaintiff alleged that defendant, in constructing the sewer negligently destroyed property and diverted water normally flowing to plaintiff's lands, depriving her of the reasonable use and benefit thereof. The court stated that the owner of the land through which non-navigable water flows is entitled to an action for damages if the water is obstructed, polluted, or diverted or if the landowner is deprived of the beneficial use thereof. In this case, however, plaintiff failed to allege that such diversion was caused by defendant's construction and consequently failed to state a cause of action. (Barnett-Florida)
W70-06490

WATER SUPPLY WELL SRC-2, STALLION RANGE CENTER, WHITE SANDS MISSILE RANGE, SOCORRO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
Forest P. Lyford.
Geological Survey Open-file report, February 1970. 26 p, 8 fig, 3 tab, 3 ref.

Descriptors: *Water supply, *Saline water, *Water wells, *New Mexico, *Desalination, Hydrogeology, Hydrologic data, Aquifers, Data collections, Water quality, Geology.
Identifiers: White Sands Missile Range (N Mex).

White Sands Missile Range water-supply well SRC-2 was drilled to augment the volume of nonpotable water available from existing well SRC-1 so that sufficient water would be available to supply a desalting plant with an input of 200,000 gpd. Well SRC-2 was completed at a depth of 700 feet, 575 feet northwest of well SRC-1. Aquifer tests made in well SRC-2 indicated that the aquifer has a transmissivity of 140 sq ft/day. Measurements made in well SRC-1 indicate a storage coefficient for the aquifer of about 0.00029. A permanent pumping rate of 160 gpm, which would yield about 230,000 gpd, is recommended for well SCR-2. Well SRC-1 is also capable of yielding similar quantities; thus, the yield of either well would supply the maximum input needed for the desalting plant. The water contains about 2,100 mg/liter of sulfate and has a dissolved-solids content of about 3,100 mg/liter. (Knapp-USGS)
W70-06513

HYDROLOGIC SITUATION NORTH OF SNIPES MOUNTAIN NEAR SUNNYSIDE, YAKIMA COUNTY, WASHINGTON,
Geological Survey, Tacoma, Wash.
H. H. Tanaka, and A. J. Hansen, Jr.
Geological Survey Open-file report, February 1970. 12 p, 5 fig, 4 ref.

Descriptors: *Water wells, *Water levels, *Aquifers, *Washington, Water yield, Drawdown, Basalts, Alluvium, Water supply, Irrigation water.
Identifiers: Well interference, Sunnyside (Wash).

The hydrologic situation north of Snipes Mountain near Sunnyside, Yakima County, Washington was studied relative to drilling of a well to produce 1,800 gpm, and the effects of such withdrawal on the yield of two nearby domestic wells. A well 400 feet deep at the proposed site probably will tap the same aquifer as the present wells, and consequently there will be interference. However, recharge caused by additional irrigation from the proposed well will lessen the interference. A rough estimate is that the pumping at the proposed well would

cause a reduction in hydraulic head amounting to several tens of feet under these conditions. (Knapp-USGS)
W70-06518

GEOHYDROLOGY OF THE CROSS-FLORIDA BARGE CANAL AREA WITH SPECIAL REFERENCE TO THE OCALA VICINITY,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04A.
W70-06534

EFFECTIVE USE AND CONSERVATION OF GROUNDWATER,
P. C. Lindenbergh.
In: Freshwater, Council of Europe, Nature and Environment Series, No 2, p 71-106, 1968. 36 p, 3 fig, 3 plate, 26 ref.

Descriptors: *Water resources development, *Groundwater, Water supply, Safe yield, Water yield, Artificial recharge, Groundwater basins, Social aspects, Legal aspects, Urbanization, Planning, Water management (Applied).
Identifiers: Water resources research.

Groundwater is one portion of the earth's hydrologic cycle. It is important to investigate development of groundwater for water supply in the most economical way. It is to be expected that the demand for groundwater will continue to increase. At present, overdraft already occurs in many groundwater basins. Until overdrafts are reduced to safe yields in groundwater basins, permanent damage or depletion of groundwater supplies must be anticipated (restrict demand). Artificial recharge is useful for reducing or terminating overdraft and may be defined as augmenting the natural replenishment of groundwater storage and, where necessary, preventing salt-water intrusion. National and international groundwater research programs are necessary to anticipate future problems and propose technical and economical solutions before groundwater projects are designed and planned. (Knapp-USGS)
W70-06570

HARTFORD RAYON CORP V CROMWELL WATER CO (DIMINUTION OF BROOK FLOW CAUSED BY WELL SINKING).

10 A2d 587-589 (Conn 1940).

Descriptors: *Connecticut, *Percolating waters, *Drawdown, *Riparian rights, Alteration of flow, Competing uses, Diversion, Judicial decisions, Legal aspects, Municipal waters, Natural use, Obstruction to flow, Prescriptive rights, Riparian land, Riparian waters, Watersheds (Divides), Water sources, Streams, Remedies, Industries, Industrial water, Water supply, Relative rights, Wells.

The plaintiff operated a manufacturing plant upon a tract of land through which flowed a brook. A dam was maintained upon plaintiff's premises and the water of the brook was adapted for processing plaintiff's products. The defendant water company bought land bordering upon the brook and within the watershed. The land was located about a mile above the plaintiff's factory. Defendant proposed to sink a well upon this land in order to provide water for the city it served. Plaintiff's action for a permanent injunction against construction of the well resulted in an adverse judgment. The Connecticut Supreme Court affirmed for defendant and held that an injunction based on the ground that the well would capture the percolating water flowing into the brook did not lie to restrain the water company from drilling the well. The court held that until it was proven that the sinking of the well would actually divert water, it could not be shown that the plaintiff had suffered any legal injury. The court reasoned that the rights of the plaintiff, claimed as a riparian proprietor and through prescription because of the use of the dam, were not to control the defendant's use of the water passing into the brook. (Powell-Florida)
W70-06660

BOROUGH OF WALLINGTON V TUBE REDUCING CORP (INDUSTRIAL WELLS IN VIOLATION OF LOCAL ORDINANCE).
42 A2d 757-758 (N J 1945).

Descriptors: *New Jersey, *Water wells, *Reasonable use, *Industries, Groundwater, Withdrawal, Wells, Injection wells, Local governments, Remedies, Zoning, Cities, Land use, Water utilization, Legal aspects, Judicial decisions, Public health, Water sources, Water supply, Pumping, Recharge.

Plaintiff municipality sought to prevent defendant corporation from withdrawing water through wells in violation of local zoning ordinance. The court held that injunction would not lie, as the bulk of the water withdrawn was discharged again through injection wells, and no irreparable harm could be shown by the plaintiff. Neither was detrimental effect on the public health and welfare shown. The court stated that the owner of land was entitled to the reasonable use of the groundwater under his property and expressed doubt as to the constitutionality of an ordinance restricting that use. As no equitable jurisdiction was shown, the bill was dismissed. (Caldwell-Florida)
W70-06676

A STUDY OF THE HYDROLOGY AND GEOLOGY OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
For primary bibliographic entry see Field 02F.
W70-06705

A STUDY OF DATA PREPARATION FOR MATHEMATICAL MODELING OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
For primary bibliographic entry see Field 02F.
W70-06706

4C. Effects on Water of Man's Non-Water Activities

ENVIRONMENTAL AND TECHNICAL FACTORS FOR OPEN DRAINAGE CHANNELS IN MILWAUKEE,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 04A.
W70-06318

HYDROLOGY OF A SMALL RURAL WATERSHED UNDER SUBURBAN DEVELOPMENT - PHASE I,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
For primary bibliographic entry see Field 02A.
W70-06447

THE EVERGLADES: A THREATENED ECOLOGY,
Miami Univ., Fla. Inst. of Marine Science.
For primary bibliographic entry see Field 06G.
W70-06539

AVAILABILITY OF RAINFALL-RUNOFF DATA FOR PARTLY SEWERED URBAN DRAINAGE CATCHMENTS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 02A.
W70-06573

FRANKLIN COUNTY COMPREHENS PLAN.
Franklin County Planning Commission, Colum Ohio.
For primary bibliographic entry see Field 06B.
W70-06710

4D. Watershed Protection

SEDIMENTATION IN PLUM CREEK S WATERSHED NO. 4, SHELBY COUN NORTH-CENTRAL KENTUCKY,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-06334

COMPILATION OF HYDROLOGIC DA ELM FORK TRINITY RIVER, TRINITY RI BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-06350

RIGHTS OF DRAINAGE; PRIVATE DRA (ROAD GRADES NOT TO OBSTRUCT NA RAL DRAINAGE).

Wis Stat Ann secs 88.87-88.94 (Supp 1969).

Descriptors: *Wisconsin, *Drainage, *Obstruc to flow, *Drainage systems, Legislation, L aspects, Surface drainage, Ditches, Drainage p tices, Drainage programs, Drainage water, L management, Highways, Roadbanks, Road struction, Embankments, Surface waters, Wa cources (Legal), Flood control, Water man ment (Applied), Railroads, Industrial water, gineering structures, Cities, Local governme Streamflow, Damages, Flood control, Contro drainage.

Whenever any county, town, city, village, rail company, or the State Highway Commission structs or maintains any highway or railroad g in or across any marsh, lowland, natural dep sion, natural watercourse, natural or man-m channel or drainage course, it must not reasonably obstruct the natural drainage of sur or stream water. The public authority of rail company may purchase drainage rights and e ments in order to prevent damage to prop owners. Ever owner or user of land who obstr the flow of stream water has a duty to prote downstream or upstream highway or railroad g from water or flooding caused by such obstruct The downstream highway or railroad grade is tected by directing the flow of surface waters existing highway or railroad drainage systems. upstream grade is protected by permitting drai away from the grade essentially as if the obst tion had not been created. A railroad comp must construct a ditch or sluiceway across its ri of-way where such structure would properly d the petitioning owner's land. Whenever any bankment, grade, culvert or bridge across a nat watercourse obstructs such watercourse diverts water upon any lands of a drainage dist the waterway flowing through such structure r be enlarged. The procedures for removal or structions from natural watercourses by a dama landowner or occupant are provided. Proced for the installation of drains by an agricultural downer are set forth. (Powell-Florida)
W70-06361

DAVIS V COBB COUNTY (STOPPAGE SPRING).
7 SE2d 324-325 (Ct App Ga 1940).

Descriptors: *Georgia, *Springs, *Obstructio flow, *Riparian rights, Natural flow doctr Reasonable use, Damages, Land tenure, N navigable waters, Streams, Judicial decisions, L aspects, Right-of-way, State governments, L

nments, Administrative agencies, Ownership
ds, Remedies, Real property, Condemnation,
nflow.

iffs alleged that defendant, while grading a
ight-of-way, dumped excess dirt into a spring,
resulted in stopping it up and shutting off the
n which naturally flowed through plaintiffs'
rty. The court said that the owner of land
gh which a non-navigable stream flowed was
d to have the water in the stream come to his
n its natural and usual flow, subject only to
dimunition as may be caused by reasonable
f the water by upstream riparian owners.
ng that the right of a riparian owner to the
f the water was equal to his right to posses-
f the beds underneath the water, the court
sed a decision below for the defendant. This
was private property, said the court, and
not be taken without compensation, re-
ss of whether the property had actually been
for public use. (Caldwell-Florida)
06368

ORTANCE OF NATURAL VEGETATION THE PROTECTION OF THE BANKS OF EAMS, RIVERS AND CANALS,
rimary bibliographic entry see Field 03B.
06401

EARCH ON SLEEPERS RIVER AT DAN-LE, VERMONT,
cultural Research Service, Plainfield, Vt.
in L. Johnson.
E Proceedings, Journal of the Irrigation and
nage Division, Vol 96, No IR1, Paper 7184, p
8, March 1970. 22 p, 8 fig, 7 tab, 13 ref, 3 ap-

riptors: *Stream gages, *Small watersheds,
nfall-runoff relationships, *Snowmelt, *Sur-
groundwater relationships, Water yield, In-
ntation, Runoff, Open channel flow, Cli-
logy, Meteorology, Evapotranspiration,
rologic cycle, Water balance, Hydrologic
get, Water quality.
tifiers: Sleepers River (Vermont).

earch in hydrology and biology at Danville,
mont is focused upon the complex physical
esses in natural watersheds, leading to
elopment of methods for predicting behavior of
aged areas. Reliability of a precipitation gage
rd for specifying daily amounts at other points
terest was investigated by establishing correla-
response surface around gages. Measurement
unoff production to streams suggests most of
contribution to storm hydrographs is produced
ne immediate vicinity of channels. Diurnal fluc-
ions in streamflow may be accounted for by
poration from streams and adjacent wet areas.
ny coliform bacteria from storm samples are of
ambed and bank origin, not from overland
ning of pollutants into streams. Cation concen-
ions in streams increase downstream, and are
ly correlative with discharge. Distribution of
atic insects in five streams was a function of
er temperature and channel velocity only. (K-
p-USGS)
0-06519

OLOGICAL CONSEQUENCES OF THE NAGEMENT OF CATCHMENT AREAS AND FLUENCE OF FORESTS ON RIVER BASINS,
Salverda.
Freshwater, Council of Europe, Nature and En-
onment Series, No 2, p 11-31, 1968. 21 p, 1 fig,
late, 76 ref.

scriptors: *Watershed management, *Forest
nagement, Water yield improvement, Flood
trol, Ecology, Vegetation effects, Planning,
onomics, Conservation, Water resources
velopment, Social aspects, Legal aspects, En-
onmental engineering.
ntifiers: River basin management.

Watershed management frequently has far-reaching ecological consequences, especially in recovering watershed areas which suffered devastation after hundreds of years of neglect and mismanagement. Afforestation is not always the method best suited to a region; numerous other measures may be preferable. Regard must be paid to social and economic interests which are often conflicting. Watershed planners have to participate in general (preferably long-term) development programs. Unsolved water supply problems have a far-reaching effect on the economy, inasmuch as the measures involved in restoring and managing watersheds may affect regions, whole countries or even adjacent countries. Conservation of natural resources also involves educational factors, which are essential to the achievement of the desired aim. A watershed program generally has two main objectives with opposing principles: control of excess water with the help of a maximum of vegetation cover; and optimum water yield by retaining a minimum vegetation cover. The principles of watershed management by means of forestry measures not only differ according to the aim in view but also highly dependent on climate, soil conditions and topography. (Knapp-USGS)
W70-06569

COMMUNITY ACTION GUIDEBOOK FOR SOIL EROSION AND SEDIMENT CONTROL,
National Association of Counties Research Foundation, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-06574

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

DETERMINATION OF DEGRADED DYES AND AUXILIARY CHEMICALS IN EFFLUENTS FROM TEXTILE DYEING PROCESSES,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
R. K. Flege.
Available from the Clearinghouse as PB-191 708, $3.00 in paper copy, $0.65 in microfiche. Environmental Resources Center, Georgia Institute of Technology, ERC-0270, March 1970. 42 p, 2 tab, 7 fig, 22 ref, append. OWRR Project B-027-GA (1).

Descriptors: *Textiles, *Dyehouse effluents, *Dye releases, *Dye degradation, *Carriers (Dye), Chemical wastes, Color, Waste treatment, Pollutants, Chemical oxygen demand, Activated sludge, Anaerobic digestion.

Selected dyes and auxiliary chemicals used in dyeing processes were tested in a laboratory environment simulating that to which dyehouse effluents would be subjected in a conventional activated sludge waste treatment process. Dyes and auxiliary chemicals studied were those most widely used today. Disperse dyes (anthraquinone) were only partially degraded in the laboratory tests. Because of the insolubility of the disperse dyes, the undegraded dyes and metabolites were separated from the degraded dyes before identification was attempted. Three fiber reactive dyes of the vinyl sulfone class studied were not appreciably degraded by the activated sludge waste treatment process. Color of the original dye persisted in the effluent and no metabolites could be identified. Dyes subjected to anaerobic digestion rapidly lost color. No indication was found that the dyes were toxic to the biota of either treatment process. Fourteen chemical auxiliaries (carriers) together with four commercial proprietory carriers were studied. Some carriers were readily degraded and some were toxic and/or inert. Commercial carriers were found more resistant to degradation than the reagent grade active chemicals used in their formulation. (Conway-Georgia Tech)
W70-06316

PRELIMINARY RESULTS FROM STATISTICAL ANALYSIS OF WATER QUALITY IN SELECTED STREAMS OF NEBRASKA,
Geological Survey, Lincoln, Nebr.
Kenneth A. MacKichan, and Neil G. Stuthmann.
Geological Survey Open-file Report, October 24, 1969. 35 p, 18 fig, 9 tab, 3 ref.

Descriptors: *Water quality, *Sampling, *Monitoring, *Nebraska, Statistical methods, Statistics, Chemical analysis, Water analysis, Correlation analysis, Regression analysis, Solutes, Electrical conductance.
Identifiers: Water quality sampling.

Chemical data for selected streams in Nebraska were analyzed statistically to determine if changes in the current sampling regimen would be desirable. Once accuracy limits are specified and estimates of the variability are obtained, the number of analyses required to define mean values for dissolved solids and individual constituents within those limits can be calculated by means of the regression function. Specific conductance, an inexpensive measurement, can be used as an independent variable to estimate the concentrations of dissolved solids and of dissociated ions such as calcium and sulfate. Other independent variables such as discharge, source of flow, and season may be used to improve the regression function. (Knapp-USGS)
W70-06349

NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS - WATER YEAR 1970.
Geological Survey, Washington, D.C. Water Resources Div.

Geological Survey National Reference List of Water Quality Stations, 1970. 701 p, 6 tab, index.

Descriptors: *Water quality, *Data collections, *Stations, Networks, Facilities, Sampling, Water analysis, Water chemistry, Monitoring, Sediment load, Water temperature.
Identifiers: Water quality stations.

The water-quality stations maintained by the U.S. Geological Survey for the collection of basic data on the chemical and physical characteristics of streams in the United States and its territories are listed. The stations are listed in alphabetical order by State, in downstream order by part (major drainage basins), and stations that discontinued operations at the end of the previous water year. Data listed for each station consists of identification number, latitude and longitude, station name, drainage area, State, county, date established, type of data collected (chemical sediment, temperature), available discharge records, frequency of sampling, type of project, source of operating funds, number of years the station has been in operation, and the constituents determined by analysis in the laboratory, in the field, or by digital monitor. This information is also summarized by State. The data collected from stations on this list may be obtained by writing the U.S. Geological Survey, Water Resources Division, Automatic Data Processing Unit, Washington, D.C. 29240. This list is prepared annually. (Knapp-USGS)
W70-06514

QUANTITATIVE METHODS FOR THE CONCENTRATION OF VIRUSES IN WASTE WATER,
Arizona Univ., Tucson. Dept. of Microbiology.
For primary bibliographic entry see Field 05D.
W70-06628

GROSS RADIOACTIVITY IN SURFACE WATERS OF THE UNITED STATES FEBRUARY 1969.
Federal Water Pollution Control Administration, Washington, D.C. Div. of Pollution Surveillance.

Radiological Health Data and Reports, Vol 10, No 9, p 394-395, 1969. 1 fig, 1 tab, 7 ref.

Descriptors: *Radioactivity, *Surface waters, *United States, Sampling, Montana, South Dakota, Tennessee, California, Arizona, Minnesota, Missouri, North Dakota, Nebraska, Colorado River, Great Lakes, Mississippi River, Missouri River, Ohio River.
Identifiers: Beta radioactivity, Alpha radioactivity, Big Horn River (Mont), Big Sioux River (S Dak), Clinch River (Tenn), Cumberland River (Tenn), Kansas River (Kans), Little Miami River (Ohio), North Platte River (Neb), Platte River (Neb), Rainy River (Minn), Red River (N Dak), South Platte River (Colo), Yellowstone River (Mont), Sampling stations.

Monitoring surface waters for radioactivity levels is part of the Water Pollution Surveillance System. Current preliminary results of alpha and beta radioanalyses are presented. Radioactivity associated with dissolved solids provides a rough indication of levels which would occur in treated water, since nearly all suspended matter is removed by treatment processes. Strontium-90 results are reported semiannually. The average total beta radioactivity in suspended-plus-dissolved solids in raw water collected at nationwide stations is given. Special note is taken when alpha radioactivity reaches 15 picocuries per liter or greater, or when beta radioactivity is at 150 picocuries per liter or greater. These arbitrary levels reflect no public health significance, as the Public Health Service drinking water standards have already provided the basis for this assessment. Changes from or toward these arbitrary levels are also noted in terms of changes in radioactivity per unit weight of solids. Comments are made on monthly average values or when values are significantly high. North Platte and South Platte Rivers showed alpha radioactivity values above 15 picocuries/liter for either suspended or dissolved solids in February 1969. No stations showed beta radioactivity value above 150 picocuries/liter in February 1969. (Jones-Wisconsin)
W70-06656

MEASUREMENT OF POLLUTANT TOXICITY TO FISH I. BIOASSAY METHODS FOR ACUTE TOXICITY,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
J. B. Sprague.
Water Research, Vol 3, p 793-821, 1969. 6 fig, 1 tab, 125 ref.

Descriptors: *Reviews, *Bioassay, *Toxicity, *Measurement, *Test procedures, Aquatic animals, *Methodology, Control systems.
Identifiers: *Median tolerance limits, Estimating error, Acute toxicity, Chronic toxicity, *Toxicity curves, Toxicity threshold.

The review describes profitable methods for measuring lethal levels of pollutants for aquatic organisms. Methods for research in the laboratory are emphasized by the same principles could be applied in field work. Greater use of standard toxicological methods and terminology is urged. For 211 out of 375 toxicity tests reviewed, acute lethal action apparently ceased within 4 days, although this tabulation may have been biased towards short times by a large number of static tests. The incipient LC50 (lethal concentration for 50 per cent of individuals on long exposure) is recommended as the most useful single criterion of toxicity. If this cannot be estimated, the 4-day LC50 is a useful substitute, and often its equivalent. A desirable first step in toxicity tests is to estimate median lethal time for each of a series of concentrations on logarithmic paper. The curve helps to reveal any unusual features of toxicity. Whenever possible, tests should be prolonged until the toxicity curve becomes parallel to the time axis, indicating a lethal threshold concentration. The incipient LC50 is then estimated by selecting an exposure time from the asymptotic part of the toxicity curve; for this exposure time, observed mortality is plotted against concentration on log-probit paper, and the LC50 is read from an eye-fitted line. (Sjolseth and Katz-Washington)
W70-06692

5B. Sources of Pollution

REVIEW OF THE SANTA BARBARA CHANNEL OIL POLLUTION INCIDENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
W. H. Swift, C. J. Touhill, W. A. Haney, R. E. Nakatani, and P. L. Peterson.
Available from the Clearinghouse as PB-191 712, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series 15080 EAG, July 1969. 156 p, 51 fig, 7 tab, 29 ref. FWPCA Project 15080 EAG---7/69, Contract 14-12-530.

Descriptors: *Oily water, *California, *Environmental effects, Oil wastes, Water pollution sources, Water pollution effects, Water pollution control, Water pollution treatment, Oil wells, Offshore platforms, Toxicity.
Identifiers: *Santa Barbara Oil Spill.

On January 28, 1969, during operations to shut in well A-21 on the offshore drilling Platform A, about 6 miles southeast of Santa Barbara in 190 feet of water, a leak of mixed crude oil and gas occurred. For the first few days the crude oil largely remained in the Santa Barbara Channel. However, starting on February 4, southeasterly winds began to drive the oil ashore, resulting in contamination of beaches, harbors and coastline, and initiating perhaps the largest oil pollution clean-up operation in the United States. Ocean floor seepage associated with the well blowout was highly variable with respect to location and magnitude with time. Attempts to control the oil on the surface near the platform were largely unsuccessful. To encompass the entire area of oil emission, booms several thousand feet in length would have been required. Chemical dispersants are questionable. Recovery of the majority of the accumulated oil was accomplished by vacuum tank trucks and manual spreading of straw. The only method effective for removal of oil stains from rocks and jetties was high pressure water washing followed by sandblasting. Total known bird losses through March 31 in the area affected were determined to be 3600. Only minimal adverse effects on fish were noted. (Knapp-USGS)
W70-06320

RECONNAISSANCE OF WATER TEMPERATURE OF SELECTED STREAMS IN SOUTHEASTERN TEXAS,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02K.
W70-06343

CONSIDERATIONS ON A SEWER OUTFALL OFF NOBSKA POINT,
Woods Hole Oceanographic Institution, Mass.
Dean F. Bumpus, W. Redwood Wright, and Ralph F. Baccaro.
Available from the Clearinghouse as AD-700 895, for $3.00 in paper copy, $0.65 in microfiche. Technical rept., Woods Hole, Rept. No. WHOI-Ref-69-87, Dec. 69, 42 p. Contract DOT-CG-92841, Grant PHS-UI-0015899.

Descriptors: *Sewage disposal, *Wafer pollution sources, Phytoplankton, Ecology, *Water pollution effects, Beaches.
Identifiers: Nobska Point, Falmouth, Mass.

The effects of prospective secondary treatment domestic sewage effluent of about 14 thousand cu m per day on the marine environment of Martha's Vineyard and Nantucket Sounds has been examined. A steady state condition would be reached in 75 days when the sewage effluent would be diluted by a volume ranging from at least 1700 to 2800 parts of redwater for each part of effluent. The concentrations of nutrients added to the Sounds and the ecological effects would be less than is experienced in the normal annual cycle.
W70-06465

RELATIVE CONTRIBUTIONS OF NUTRIE TO THE POTOMAC RIVER BASIN FR VARIOUS SOURCES,
Federal Water Pollution Control Administrat Annapolis, Md.; and New York State Dept Health, Albany. Div. of Environmental Health vice.
Norbert A. Jaworski, and Leo J. Hetling.
Chesapeake Technical Support Labora Technical Report No 31, Federal Water Pollu Control Administration, January 1970. 36 p, 13 6 tab, 8 ref.

Descriptors: *Nutrients, *Eutrophication, *W pollution sources, *Estuaries, Rivers, Phospha Nitrates, Hudson River, Algae, Water qua Sewage disposal, Waste water disposal, Sewage fluents, Farm wastes.
Identifiers: Potomac River Basin, Potomac estu

The upper Potomac estuary is highly eutrop During the summer months, large blooms nuisance blue-green algae, mainly microcy occur in the fresh-water portion of the upper es ry. A relationship between high nutrient con and the accelerated eutrophication in the Poto estuary has been established. The annual ave concentration of phosphorus varied from mg/liter in the South Branch to 1.9 mg/liter in Antietam watershed. The annual average con tration of nitrogen varied from 0.3 mg/liter in South Branch to 2.2 mg/liter in Opequon Cr About 92,700 lbs/day of total phosphorus ent the Potomac in 1966, 87% from wastewater. average 1966 loading of total nitrogen was a 125,000 lbs/day, 51% from wastewater. During flow conditions a significant proportion of phosphorus entering the surface water from various sources in the upper basin is retained in stream channel. At high stream flow, it appears a large proportion of this phosphorus is 'flus out of the stream channel and transpo downstream. A comparison of sources of nutri in the Hudson River Basin to those in the Poto supports the contention that in the Middle Atla Region the major source of nutrients to the aqu ecosystem is from wastewater discharges. (Kn USGS)
W70-06509

TRITIUM CONCENTRATION IN PRECIP TION, 1967-1968,
Southwestern Radiological Health Lab., Las Ve Nev.; and Southeastern Radiological Health L Montgomery, Ala.
A. A. Moghissi, and C. R. Porter.
Radiological Health Data and Reports, Vol 11 3, p 137-140, March 1970. 4 p, 3 fig, 2 tab, 8 re

Descriptors: *Tritium, *Precipitation (Atmosp ic), *Sampling, *Monitoring, Data collections, lout, Tracers, Hydrologic cycle, Radiochem analysis, Networks.
Identifiers: Tritium sampling network.

Since the discovery of natural tritium, rain has extensively monitored to study the production behavior of this radionuclide in the hydrolo cycle. It has been well established that under mal conditions--in the absence of the introduc of tritium by nuclear bomb testing--tritium con tration in rain will increase during spring and summer in the Northern Hemisphere. In Southern Hemisphere the conditions are sim although less pronounced. Numerous studies shown that tritium concentrations reach a imum at latitude 45-60 deg N in the Nort Hemisphere. Beginning in 1967, the Bureau Radiological Health established a tritium-in network as part of the existing Radiation Alert work. Ten stations were selected covering United States, including Alaska and the Hawa Islands. The locations of these stations are sh (Knapp-USGS)
W70-06515

OSPHERIC EMISSIONS FROM WET-SPHORIC ACID MANUFACTURE,
nal Air Pollution Control Administration, gh, N.C.; and American Cyanamid Co., e, N.J.
ge B. Crane, Donald R. Goodwin, and James ok.
s avail for sale from Superintendent of Docu-, US Government Printing Office, Wash, DC 2--Price: $0.45. National Air Pollution Con-dministration Publication No AP-57, April 86 p, 12 fig, 20 tab, 39 ref.

iptors: *Air pollution, *Phosphorus com-ds, *Industrial plants, Chemical wastes, Water ion sources, Phosphates, Fertilizers, ides, Agricultural chemicals, Sampling, tical techniques, Pollution abatement.
ifiers: *Atmospheric emissions, Phosphoric nanufacture, Process description.

ovide reliable information on the nature and ity of emissions from chemical manufactur-he Manufacturing Chemists' Assoc., Inc., and HS, HEW, began a study in 1962 of emissions selected processing plants and to publish data ul to air pollution control and planning agen- and to chemical industry management. ground information is given on basic charac-ics of the wet-process phosphoric acid indus-rowth rate, uses for products, and number and ion of producing sites. The process involves nent of phosphate rock with sulfuric acid. riptions are given of commonly used process tions. Emission data represent about 20% of perating plants. Range of emissions under nor-perations and the performance of established ods and devices for controlling emissions are ibed. In 1966, about 3.5 tons of phosphoric (P205) was produced, mostly for various phate fertilizer products. Dust from phosphate grindings and fluoride compounds liberated lfuric acid are a potential source of air and r pollution. Total particulate emissions nt to about 0.20 lb per ton of acid for filter ation, and as much as 11 lb per ton for digester ation. Gypsum ponds contribute fluoride emis- depending on pH, temperature and wind d--one pond studied showed a range of 0.4 to b of fluoride per acre per day, varying with erature. (Lang-USGS)
-06521

ECTION OF REFUSE DISPOSAL SITES IN THEASTERN ILLINOIS,
is State Geological Survey, Urbana.
ge M. Hughes.
is State Geological Survey Environmental ogy Note No 17, September 1967. 18 p, 2 fig, , 41 ref.

riptors: *Waste disposal, *Garbage dumps, ndfills, *Path of pollutants, *Hydrogeology, nois, Municipal wastes, Leaching, Ground-r movement, Environmental sanitation, En-nmental engineering, Water pollution sources.
tifiers: Environmental geology.

logic environments in northeastern Illinois evaluated in terms of results of studies on se disposal and groundwater contamination have been made elsewhere. The geologic en-nments commonly considered as safe for refuse osal in this area are those with materials of low neability and those that are relatively dry. A l type of environment, one which is hydrologi-protective, also should be considered for osal purposes. (Knapp-USGS)
0-06572

ERMAL POLLUTION AND THE WATER OLING TOWER,
ley Co., Kansas City, Mo.
primary bibliographic entry see Field 05D.
0-06640

EFFECT OF A STABILIZING GRADIENT OF SOLUTE ON THERMAL CONVECTION,
Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics.
George Veronis.
Journal of Fluid Mechanics, Vol 34, Part 2, 1968, p 315-336. 5 fig, 7 ref, 3 tab.

Descriptors: *Convection, Stratification, Diffusion.
Identifiers: *Prandtl number, *Rayleigh number, Thermal convection.

A stabilizing gradient of solute inhibits the onset of convection in a fluid which is subjected to an adverse temperature gradient. Furthermore, the onset of instability may occur as an oscillatory motion because of the stabilizing effect of the solute. These results are obtained from linear stability theory which is reviewed briefly in this paper before finite-amplitude results for two-dimensional flows are considered. A solute Rayleigh number, R sub s, is defined with the stabilizing solute gradient replacing the destabilizing temperature gradient in the thermal Rayleigh number. An effective diffusion coefficient, kappa sub rho, is defined as the ratio of the vertical density flux to the density gradient evaluated at the boundary and it is found that kappa sub rho = minus the square root of (kappa (kappa sub s)) where kappa, kappa sub s are the diffusion coefficients for temperature and solute respectively. (Guerrero-Vanderbilt)
W70-06641

THE UNSTABLE THERMAL INTERFACE,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 08B.
W70-06643

THE THERMOHALINE RAYLEIGH-JEFFREYS PROBLEM,
Auckland Univ. (New Zealand). Dept. of Mathematics.
D. A. Nield.
Journal of Fluid Mechanics, Vol 29, Part 3, 1967, p 545-558. 30 ref.

Descriptors: *Thermal stratification, *Numerical analysis, *Thermocline, Convection.
Identifiers: *Thermohaline, Thermal gradient.

The onset of convection induced by thermal and solute concentration gradients, in a horizontal layer of a viscous fluid, is studied by means of linear stability analysis. A Fourier series method is used to obtain the eigen value equation, which involves a thermal Rayleigh number R and an analogous solute Rayleigh number S, for a general set of boundary conditions. Numerical solutions are obtained for selected cases. Both oscillatory and monotonic instability are considered, but only the latter is treated in detail. The former can occur when a strongly stabilizing solvent gradient is opposed by a destabilizing thermal gradient. When the same boundary equations are required to be satisfied by the temperature and concentration perturbations, the monotonic stability boundary curve in the (R, S)-plane is a straight line. Otherwise this curve is concave towards the origin. For certain combinations of boundary conditions the critical value of R does not depend on S (for some range of S) or vice versa. This situation pertains when the critical horizontal wave-number is zero. A general discussion of the possibility and significance of convection at 'zero' wave-number (single convection cell) is presented in an appendix. (Guerrero-Vanderbilt)
W70-06644

THE INFLUENCE OF MOLECULAR DIFFUSIVITY ON TURBULENT ENTRAINMENT ACROSS A DENSITY INTERFACE,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 08B.
W70-06646

ON STRATIFIED FLOWS OVER BOTTOM TOPOGRAPHY,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 02E.
W70-06649

ACIDIC DISSOCIATION CONSTANTS OF SELECTED AQUATIC HERBICIDES,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
Nancy Hunter Nelson, and Samuel D. Faust.
Environmental Science and Technology, Vol 3, No 11, p 1186-1188, 1969. 2 tab, 13 ref.

Descriptors: *2-4-D, *Herbicides, *Organic acids, Aquatic plants, Dalapon, 2-4-5-T, Potentiometers, Adsorption, Ion exchange, Coagulation.
Identifiers: Classical dissociation constant, 2-CPA, 4-CPA, MCPAN, MCPB, Fenac, Aquatic herbicides, Dissociation constants, Potentiometric titration.

Dissociation constants (pK) of organo-acidic aquatic herbicides at definite ionic strength (I) were established by potentiometric titration, as follows: for 2,4-D (2.73, I--0.05); 2,4,5-T (2.88, I--0.03); 2-CPA (2.92, I--0.05); 4-CPA (2.95, I--0.05); MCPA (3.05, I--0.03); MCPB (4.80, I--0.05); fenac (3.70, I--0.05); dalapon (1.84, I--0.05). A knowledge of dissociation constants is essential for calculation of the distribution of undissociated acid and anion species of herbicides under given pH and ionic strength. The availability of the molecule to enter oxidation-reduction reactions, dissolution, ionic exchange, coagulation, and adsorption is also influenced by dissociation constant of the eradicant. (Wilde-Wisconsin)
W70-06663

WATER QUALITY PROBLEMS PECULIAR TO ARID REGIONS,
New Mexico State Univ., University Park. Dept. of Soil Chemistry.
For primary bibliographic entry see Field 03B.
W70-06682

5C. Effects of Pollution

REVIEW OF THE SANTA BARBARA CHANNEL OIL POLLUTION INCIDENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05B.
W70-06320

GEOLOGIC INVESTIGATION OF THE SITE FOR AN ENVIRONMENTAL POLLUTION STUDY,
Illinois State Geological Survey, Urbana.
Paul B. DuMontelle.
Illinois State Geological Survey Environmental Geology Note No 31, March 1970. 19 p, 4 fig, 1 tab, 4 ref, append.

Descriptors: *Water pollution effects, *On-site investigations, *Soil investigations, *Geologic investigations, *Illinois, Hydrologic data, Geology, Hydrology, Hydrogeology, Infiltration, Permeability, Sampling, Groundwater movement, Path of pollutants, Environment.
Identifiers: Test holes, University of Illinois, Environmental pollution.

To study the effects of pollutants under simulated natural-flow conditions, the Illinois Natural History Survey is planning a study area containing 16 large ponds and 6 smaller ponds, interconnected by a central drain and a catchment basin. The larger ponds will measure 190 by 50 ft and the smaller ones 85 by 36 ft. They will be from 4 to 8 ft deep. The Champaign glacial moraine forms a prominent ridge trending northwest-southeast through the south part of Champaign and Urbana. The south side of the moraine has a very gentle slope of about 50 ft per mile, which exhibits the poorly defined

drainage system typical of topography related to glaciation. These uplands are undissected, but are a part of the Embarras River watershed to the south. The proposed site for the environmental pollution study is located in the mid-part of the south slope of the Champaign Moraine. The site chosen for the environmental pollution project is geologically feasible. The rectangular-shaped ponds may be satisfactorily constructed of in situ materials if some precautions are taken. (Knapp-USGS)
W70-06322

THE REDOX POTENTIALS IN SMALL OLIGO AND MEROMICTIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
Johannes Kjensmo.
Nordic Hydrology, Vol 1, No 1, p 56-65, 1970. 10 p, 4 fig, 1 tab, 13 ref.

Descriptors: *Water chemistry, *Oxidation-reduction potential, *Meromixis, *Lakes, Water circulation, Water quality, Hydrogen sulfide, Oxidation.
Identifiers: Oligomixis.

The vertical distributions of redox potentials of the waters of three meromictic lakes and one oligomictic lake are described. The redox potentials of the waters from 0.5 m depth of the various lakes ranged from 0.491 to 0.565 volts. The bottom waters showed potentials in the range 0.030 to 0.069 volts. Lower potentials observed in 2 of the lakes may be due to the presence of reducing organic substances. The 2 lakes are typical coniferous forest lakes, and their catchment areas are relatively rich in Sphagnum bogs. The very small influence of the oxygen concentration on the oxygen potential is clearly demonstrated by the present investigation. In all 4 lakes the greatest fall in redox potential was recorded at depths well below the depths at which oxygen was analytically detectable. Characteristic for the lakes are high contents of iron in their deep waters. Considerable amounts of free hydrogen sulfide were present in the deep waters of the oligomictic lakes, a fact which was confirmed by a strong smell of hydrogen sulfide arising from this water. Hydrogen sulfide may have been the additional factor responsible for the lower potentials of this water as compared with the potentials of the deep waters of the three meromictic lakes. In the three meromictic lakes there was no smell of hydrogen sulfide from the deep waters. (Knapp-USGS)
W70-06327

EVALUATION OF THE EFFECT OF IMPOUNDMENT ON WATER QUALITY IN CHENEY RESERVOIR,
Colorado State Univ., Fort Collins.
J. C. Ward, and S. Karaki.
Supported by Bureau of Reclamation, Dept of Interior. Colorado State University Hydrology Paper No 38, March 1970. 69 p, 38 fig, 19 tab, 23 ref, append.

Descriptors: *Water quality, *Reservoirs, *Kansas, Thermal stratification, Dissolved oxygen, Water temperature, Sampling, Streamflow, Taste, Odor, Aquatic, Microorganisms, Water chemistry, Heat budget, Hydrologic budget, Salinity, Turbidity, Evaporation control, Reservoir design, Reservoir evaporation.
Identifiers: Cheney Reservoir (Kansas).

A study was conducted to determine the effect of impoundment on the quality of water in Cheney Reservoir. The reservoir did not stratify during the period of data collection. The increase in the dissolved solids concentration was shown to be directly related to evaporation. On an annual basis, 42 percent of the total inflow evaporated. Suggestions are presented for control of dissolved solids concentration. Evaporation control is suggested, but increase in reservoir temperature (12 to 19 deg F) may be undesirable. Bypassing some of the poorest quality waters of the stream serving Cheney Reservoir is suggested in order to reduce the dissolved solids concentration both in the reservoir and in the stream below the reservoir. The biological activity did not seem to affect the water quality materially. Odor stabilized at a threshold odor number of about 5. The dissolved oxygen saturation decreased somewhat from 100 percent at the water surface to roughly 82 percent at a depth of 25 feet. (Knapp-USGS)
W70-06336

A STUDY SUBMERGED DREDGE HOLES IN NEW JERSEY ESTUARIES WITH RESPECT TO THEIR FITNESS AS FINFISH HABITAT,
New Jersey Dept. of Conservation and Economic Development. Nacote Creek Research Station.
For primary bibliographic entry see Field 02L.
W70-06362

RELATIVE CONTRIBUTIONS OF NUTRIENTS TO THE POTOMAC RIVER BASIN FROM VARIOUS SOURCES,
Federal Water Pollution Control Administration, Annapolis, Md.; and New York State Dept. of Health, Albany. Div. of Environmental Health Service.
For primary bibliographic entry see Field 05B.
W70-06509

BIOLOGICAL EXTRACTION OF NUTRIENTS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06604

THE ROLE OF NITRATE NITROGEN IN BIOOXIDATION,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06607

THE EFFECT OF STERILIZATION TECHNIQUES ON WASTE WATER PROPERTIES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06610

IMPROVED METHODS FOR EVALUATION OF THERMAL DISCHARGE PRACTICES AND ALTERNATIVE ACTIONS,
Battelle-Northwest, Richland, Wash.
R. T. Jaske.
Institute of Environmental Sciences, 1970 Annual Technical Meeting, Proceedings, Boston, April 12-16, 1970, p 261-266. 6 fig, 9 ref.

Descriptors: Thermal discharges, Hydraulics, Temperature, Thermal capacity, Irrigation.
Identifiers: COLHEAT system, Temperature model, V-test.

COLHEAT, a deterministic stream temperature prediction system, describes the thermal regimen of a river or estuary and permits advance estimates of thermal effects of impoundments, single thermal plants, or an extended series of thermal and hydro installations with overlapping effects on a single or regionally combined watershed. The basic operation is a two step process: multiple shell or zonal transport system with adjustable allocation of inter- and intra-shell transport. Assuming that most streams will be turbulent and relatively homogeneous in hydraulic characteristics, the distribution of velocity contours within the stream will be similar for width to depth ratios exceeding 24. Based on this concept, the model sets up a series of difference equations and, using applicable budget methods based on continuity, iteratively computes the downstream temperatures as a function of the input parameters. In its initial operation, the rudimentary system was used to evaluate the manipulation of the discharges of Grand Coulee Dam, Deerfield River simulation, and on the upper Mississippi River Basin system with great success. economics and technology of thermally elev condenser discharges for agricultural usage critical examination. The study covering the op tion of a 1000 MW thermal station discha heated effluent into the distribution canal syste Phelps County, Nebraska, reveals that the pr plant heat load is fully attenuated within the measurement, plus or minus 0.5 C, in 25 mil main canal. A 500 MW nuclear plant could be on the present system and the heat attenuat the rate of 0.13 deg C per mile. (Upadhyaya-derbilt)
W70-06635

A VIEW OF THE PROBLEM OF THER POLLUTION, WITH SPECIAL REFERENC THE WHITE RIVER IN INDIANA,
Indiana Univ., Bloomington. Water Resou Research Center.
M. A. Proffitt.
Institute of Environmental Sciences, 1970 An Technical Meeting, Proceedings, Boston, Apri 16, 1970, p 258-260. 6 ref.

Descriptors: *Thermal pollution, *The discharge, Dissolved oxygen, Turbidity, Tem ture, *Biochemical oxygen demand, *Fish, Ind
Identifiers: White River.

Six steam electric plants discharge into the app mately 350 mile length of the West Fork of W River. Their total capacity is 1100 megawatts their requirement for cooling water is estimat be about 1250 cfs. The study at Petersburg been a continuing survey of the fish and m scopic invertebrates, together with measuren of temperature, oxygen, turbidity, and BOD evidence of organic pollution has been found 5-day BOD test has usually been in the 10-20 range. Temperature 600 ft. downstream fro outfall are generally not more than 10 deg F a the ambient river temperature. Though more 1000 tests have been made during five years, have shown less than 6 ppm dissolved oxygen main stream. Turbidity is considerable and s times extremely high. It seems likely that the cies of fish of importance at Petersburg can to a temperature of 95 deg F for at least several Young fish are apparently just as resistant to temperatures as adults, and perhaps more so 97 deg F mark was reached three times durin past decade in White River, and yet no fish ever reported. It is possible to develop temper standards that will permit economical cooli industry and yet protect the fishes and man's river interest. (Upadhyaya-Vanderbilt)
W70-06642

THE BALANCE BETWEEN LIVING AND D MATTER IN THE OCEANS,
Kiel Univ. (West Germany). Institut Meereskunde.
For primary bibliographic entry see Field 02L.
W70-06652

DISPERSAL OF ALGAE, PROTOZOANS, FUNGI BY AQUATIC HEMIPTERA, TRIC TERA, AND OTHER AQUATIC INSECTS,
North Texas State Univ., Denton. Dept. of Bio
Kenneth W. Stewart, Larry E. Milliger, and Bernard M. Solon.
Annals of the Entomological Society of Am Vol 63, No 1, p 139-144, 1970. 1 fig, 2 tab, 13

Descriptors: *Algae, *Protozoa, *Fungi, *A insects, *Dispersion, Caddisflies, Stoneflies, sonflies, Mayflies, Cyanophyta, Chloro Chrysophyta, Chlorella, Rotifers, Chlamydom Phytoplankton, Zooplankton, Periphyton.
Identifiers: *Hemiptera, *Trichoptera, Co Eudorina, Notonectidae, Bodo, Hydropsyc Plecoptera, Magaloptera, Ephemeroptera, nochloris, Chloroccoccum, Microcystis, Fus Trichorixa, Ramphocorixa, Sigara, Boenoa, S la, Crynellus, Cheumatopsyche, Triaenod

Oecetis, Leptocella, Isonychia, Caenis, Per-

species of aquatic insects studies (5 aquatic ptera, 5 caddisflies, 1 stonefly, 2 dobsonflies, mayflies) 15 were found to be transporting nera of viable small aquatic organisms. Three ds carried 5 genera of blue-green algae, 11 algae, 1 yellow-green alga, 2 protozoans, and Eudorina, representing colonial volvocalean was found for the first time on field-exposed ic insects. Suitability of the Corixidae and nectidae as passive dispersal vehicles for small isms is discussed. Only one of six caddisflies d carried algae and protozoans, but that spe- Hydropsyche orris Ross, carried 10 genera. isms taken in casual samplings of Plecoptera, loptera, and Ephemeroptera are indicated. ding fungi, Chlorella was the most common form transported, followed by Bodo, Nan- oris, Chloroccoccum, and Microcystis, in of frequency of occurrence. Unidentified and Fusarium were carried by more than 75% e 16 insects sampled and occurred in more 50% of the 112 culture samples. These data er substantiate accumulating evidence that ic insects are among the most important over- passive transport vehicles for such organisms, ibuting to their maintenance in, and distribu- nto, suitable isolated aquatic habitats. (Jones- nsin)
06655

OBIC HETEROTROPHIC BACTERIA IN- NOUS TO pH 2.8 ACID MINE WATER: ROSCOPIC EXAMINATION OF ACID EAMERS,
State Univ., Columbus. Dept. of Microbiolo-

ck R. Dugan, Carol B. MacMillan, and Robert ister.
nal of Bacteriology, Vol 101, No 3, p 973-981, . 14 fig, 17 ref.

riptors: *Aerobic bacteria, *Acid mine water, d streams, Slime, Chemical analysis, Hydrogen concentration, Oxidation-reduction potential, logical studies, Microenvironment, Sulfates, Hydrogen, Appalachian Mountain Region, , Temperature, Sampling, Microscopy, Ul- olet radiation, Electron microscopy.
ifiers: *Acid streamers, Microcolonies, saccharide stain, Escherichia coli, Aerobacter genes, Extracellular fibrils, Freeze-etching, Hollow Mine (Ohio), Phase-contrast.

nage from the highly acidic (pH 2.8) Hope ow Mine, Ohio, was selected for study because amers' suspected to be of bacterial origin were rved in the water at the mine entrance. The streamers' consisted of bacteria trapped n an extracellular fibrillar polymer network. ganic compounds also precipitate within the mer network. Several bacteria which appear to ivergent and are presumed to be different spe- are associated in the slimy mass of the 'acid mers.' The 'streamers' contain individual ocolonies or microcosms that can be recog- d by a selective polysaccharide stain, which ests that the slime streamer is a conglomera- of polymers produced by more than one spe- The organisms produce extracellular fibrils h adhere to form the matrix. The bacteria in mers are not iron- or sulfur-oxidizing au- phs. The question of nutrients to support the rotrophs has not been thoroughly investigated, low concentrations of nutrients are presumed be present in acid water. Freeze-etching nique, as compared to carbon replication, for rvation of extracellular fibrils and their ecolog- implications, is valuable. (Jones-Wisconsin)
-06667

ANSFER OF RADIOISOTOPES BETWEEN TRITUS AND BENTHIC MACROINVER-TEBRATES IN LABORATORY MICROECOSYSTEMS,
Oak Ridge National Lab., Tenn. Radiation Ecology Section.
Jerry L. Wilhm.
Health Physics, Vol 18, No 3, p 277-284, 1970. 3 tab, 14 ref.

Descriptors: *Radioisotopes, *Detritus, *Benthic fauna, *Invertebrates, *Microenvironment, *Ecosystems, Cesium, Cobalt radioisotopes, Algae, Radioactivity, Trophic level, Life history studies, Time, Snails, Radioactive wastes, Tennessee, Crayfish, Midges, Gamma rays, Bloodworms, Sludge worms.
Identifiers: *Macroinvertebrates, Ruthenium-106, Cesium radioisotopes, Spirogyra, Limnodrilus hoffmeisteri, Stictochironomus annuliorus, Physa heterostropha, Procladius, White Oak Lake (Tenn), Uptake.

Ruthenium-106, cesium-137 and cobalt-60 transfer between detritus or algae and benthic macroinvertebrates was studied in laboratory microcosms. Detritus or algae containing radioisotopes was collected from a lake serving as settling basin for partially decontaminated waste water; four species of detritus feeders and one carnivorous specie were taken from a constant temperature spring. Mean initial activity in picocuries per ash-free grams in whole detritus was 28,800 for ruthenium-106, 6630 for cesium-137 and 6870 for cobalt-60, while values in Spirogyra were 135,000, 4930, and 62,100, respectively. Radioisotopes were present in intermediate concentrations in pulverized detritus. When whole detritus was used, activity of all three radioisotopes was greater in Limnodrilus hoffmeisteri than in Stictochironomus annuliorus; when pulverized detritus or algae was used as nourishment source, the reverse was true. Physa heterostropha was intermediate between Limnodrilus and Stictochironomus in activity. Peak concentrations of radioisotopes in detritus feeders were reached by day 3, while Procladius had delayed uptake, increasing in activity until day 14. Ruthenium-106 was detected in all life stages and exuviae of Stictochironomus; cesium-137 and cobalt-60 were detected only in larvae. Activity of ruthenium-106 in adults was 1/3 less than in larvae. (Jones-Wisconsin)
W70-06668

GROWTH RATE OF SPHAEROTILUS IN A THERMALLY POLLUTED ENVIRONMENT,
Indiana Univ., Indianapolis. Dept. of Microbiology.
Thomas L. Bott, and Thomas D. Brock.
Applied Microbiology, Vol 19, No 1, p 100-102, 1970. 2 fig, 8 ref.

Descriptors: *Growth rate, *Sphaerotilus, *Thermal pollution, *Environment, Ultraviolet radiation, Temperature, Microorganisms, Streams, On-site tests, Laboratory tests.
Identifiers: Generation time, Swarmer cells, Colonization.

A study was made of the growth and function of microorganisms in the natural environment, employing Sphaerotilus, a widespread organism in flowing waters, especially those subject to organic pollution. The test stream originates as a series of cold, hard water springs and receives thermal and organic pollution primarily in the form of steam condensate from a heating system and from the cooling water of a system manufacturing distilled water. The organism is sufficiently large and morphologically distinct to be recognized directly microscopically. In situ growth of Sphaerotilus on microscope slides immersed in the thermally polluted stream was observed. Ultraviolet radiation was used to differentiate between passive attachment from the water and growth of the organisms on slides. Colonization of the slides took place solely by means of swarmer cells. A generation time of 2.3 hours was obtained at a water temperature of 18 to 22C. It is invalid to assume, however, that colonization of new substrates will occur only by unicellular swarmer cells in all habitats. In a grossly polluted habitat, with much drift of filamentous Sphaerotilus masses, attachment and subsequent growth of filaments may occur. (Jones-Wisconsin)
W70-06669

DETERGENT ENZYMES: BIODEGRADATION AND ENVIRONMENTAL ACCEPTABILITY,
Monsanto Co., St Souis, Mo. Inorganic Chemicals Div.
For primary bibliographic entry see Field 05G.
W70-06673

EFFECT OF ENVIRONMENTAL FACTORS ON BENTHAL OXYGEN UPTAKE,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
Archie J. McDonnell, and S. Douglas Hall.
Journal of Water Pollution Control Federation, Vol 41, No 8, Part 2, p R353-R363, 1969. 7 fig, 5 tab, 20 ref.

Descriptors: *Environmental effects, *Benthos, *Oxygen, *Dissolved oxygen, Invertebrates, Depth, Microenvironment, Temperature, Respiration, Biochemical oxygen demand, Scour, Diffusion, Pennsylvania, Density, Nitrogen, Tubificids, Worms.
Identifiers: *Uptake, Spring Creek (Pa), Total solids, Volatile solids, Chironomid larvae, Macroinvertebrates.

An attempt is made to define the relative effects--such factors as oxygen concentration, temperature, and character of the biologic community--have on the oxygen demand of benthal deposits sampled from a mildly polluted eutrophic stream. The macroinvertebrate population consisted primarily of tubificid worms and chironomid larvae. In benthal deposits containing large populations of macroinvertebrates, the oxygen concentration of the system may be lowered sufficiently by invertebrate respiration to depress the oxygen uptake attributed to the microbial populations. Results reinforce previous conclusions that oxygen uptake rates of benthal systems are dependent on oxygen concentration and temperature, and essentially independent of sample depth. The presence of measurable densities of macroinvertebrates proved significant to the characteristics of the benthal response. An attempt was made to approximate, by a relatively simple procedure, the demands associated with microbial and invertebrate respiration, thereby delineating the relative importance of each. Microbial respiration accounted for 48 and 45%, and invertebrate respiration 52 and 55%, of the benthal demand in the 2-centimeter and 25-centimeter samples, respectively. Such allocation for a given stream situation is necessary to the definition of engineering limits within which a stream model may be structured. (Jones-Wisconsin)
W70-06674

DIFFERENT TOXIC MECHANISMS IN KRAFT PULP MILL EFFLUENT FOR TWO AQUATIC ANIMALS,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
J. B. Sprague, and D. W. McLeese.
French Resume included. Water Research, Vol 2, p 761-765, 1968. 3 figs, 12 refs.

Descriptors: *Bioassay, *Atlantic salmon, *Lobsters, *Toxicity, *Biological treatment, Waste treatment, Water pollution effects.
Identifiers: *Bleached Kraft Mill effluent, Homarus americanus larvae, *Bio-oxidation, Toxicity changes.

Bleached kraft mill effluent (BKME) was reported to contain at least two different toxic mechanisms or materials which affect aquatic animals. BKME stored under clean and quiescent conditions, lost much of its toxicity for salmon parr (Salmo salar L.) in 1 week, and all in 2 weeks. By contrast, it lost

little toxicity to lobster larvae (Homarus americanus MilnesEdwards) in 2 weeks. Bio-oxidation of BKME for 1 week eliminated toxicity for salmon parr, but did not greatly change toxicity for lobster larvae. Bio-oxidation for 2 weeks reduced but did not eliminate toxicity to lobster larvae. A waste treatment process which reduces toxicity of BKME for one species may not protect other species. (Sjolseth and Katz-Washington)
W70-06691

MEASUREMENT OF POLLUTANT TOXICITY TO FISH I. BIOASSAY METHODS FOR ACUTE TOXICITY,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 05A.
W70-06692

OXYGEN UPTAKE RATE OF THE JAPANESE SPINY LOBSTER AS RELATED TO THE ENVIRONMENTAL OXYGEN CONCENTRATION,
Tokyo Univ. (Japan). Fisheries Inst.
Nimura Yoshihachiro, and Inoue Masaaki.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 35, No 9, September 1969. p 852-861, 26 ref, 7 fig.

Descriptors: *Oxygen requirements, *Respiration, *Lobsters, Water temperature, *Animal metabolism, Diurnal, Animal behavior, Animal physiology.
Identifiers: *Panulirus japonicus, *Oxygen uptake rate, Active metabolic rate, Standard metabolic rate, Oxygen debt, Molting, Starvation, *Scope of activity.

The oxygen uptake rate was measured on the Japanese spiny lobster in relation to the ambient oxygen concentration and it was found that: (1) The rate increased near sunset and before sunrise, (2) the lobster paid the oxygen debt, (3) the standard metabolic rate (SMR) was constant at oxygen concentrations above the incipient lethal level, which was about 1.0 ml 0 sub 2/l both in summer and winter, (4) the apparent SMR or low routine metabolic rate (RMR) was a double of SMR, and decreased in the range below 2.0-2.5 ml 0 sub 2/l, (5) the active metabolic rate (AMR) amounted to more than six times SMR, and decreased with the reduction of oxygen concentration in the range below 3-4 ml 0 sub 2/l, effect of temperature and body size on the SMR and AMR was evaluated, and the regression equations were obtained, (7) after molting the low RMR increased and fluctuated more widely, and (8) starvation did not change the RMR for two weeks. (Sjolseth and Katz-Washington)
W70-06693

DDT PERSISTENCE IN WILD HARES AND MINK,
Maine Univ. Orono. Dept. of Entomology.
J. A. Sherburne, and J. B. Dimond.
Journal of Wildlife Management, Vol 33, No 4, p 944-948, October 1969. 1 fig, 4 tab, 18 ref.

Descriptors: *DDT, *Pesticide residues, Chlorinated hydrocarbon pesticides, Mink, Gas chromatography, Maine, *Persistence, Forest soils, Food chains.
Identifiers: *Lepus americanus, *Mustella vison, *DDD, *DDE, Tissue analyses, Forest spraying.

Residue data in wild hares (Lupus americanus) and mink (Mustells vison) following light applications of DDT to the forest are presented. Residues of from 0.5 to 2.6 ppm DDT and its metabolites are shown to persist in mink up to 9 years after a single application of 1 lb/acre. Results of analyses of adult hares and hare fetuses show low residue levels throughout 10 years following spraying that are not significantly different (P 0.05 from levels found in hares from untreated forests. Patterns of DDT residue levels and persistence shown for these species are compared with similar patterns shown for other mammalian herbivores and predators. (Sjolseth and Katz-Washington)
W70-06694

SOME RELATIONS OF TEMPERATURE ACCLIMATION AND SALINITY TO THERMAL TOLERANCE OF THE BLUE CRAB, CALLINECTES SAPIDUS,
Bureau of Commercial Fisheries, Beaufort, N.C. Biological Lab.
Marlin E. Tagatz.
Transactions of the American Fisheries Society, Vol 98, No 4, p 713-716, Oct 1969. 1 tab, 2 fig, 12 ref.

Descriptors: *Thermal pollution, Thermal stress, *Acclimatization, Crabs, Water pollution effects, *Bioassay, Water temperature, *Salinity, *Toxicity.
Identifiers: *Blue Crab, Callinectes sapidus, Median tolerance limit, *Thermal tolerance, *Temperature acclimation.

The 48 hour median thermal tolerance limits of adult and juvenile blue crabs in relation to salinity and preceding acclimation temperature were estimated from experimental data. Crabs were less tolerant to temperature extremes at low salinity, and at both low (6.8%) and high (34%) salinities, the upper and lower tolerance limits increased as the acclimation temperature increased. Almost all 48 hr TLm in 6.8% water were 0.2 to 2.0C less than those for crabs in 34% sea water. Lethal temperatures produced initial heat shock which was characterized by loss of equilibrium and erratic and rapid swimming. No sexual differences in thermal tolerance were observed. (Sjolseth and Katz-Washington)
W70-06695

EFFECTS OF 'SOFT' DETERGENTS ON EMBYROS AND LARVAE OF THE AMERICAN OYSTER (CRASSOSTREA VIRGINICA),
Bureau of Commercial Fisheries, Milford, Conn.
Anthony Calabrese, and Harry C. Davis.
1966 Proceedings of the National Shellfisheries Association, Vol 57, p 11-16, June, 1967. 3 tab, 6 ref.

Descriptors: *Linear Alkylate Sulfonates, *Detergents, Bioassay, *Oysters, Mortality, *Toxicity, Growth rates, Sewage effluents, *Larvae, Embryonic growth stage, Larval growth stage, Marine fisheries.
Identifiers: *Crassostrea Virginica, Detergent degradation products development.

Experiments were designed to determine the toxicity to oyster embryos and larvae of a standard linear alkylate sulfonate (LAS) detergent, a commercial liquid LAS detergent, and sewage effluent with and without degradation products of LAS. The percentage of fertilized eggs developing normally was reduced significantly at concentrations greater than 0.025 mg/l of the standard LAS and 0.25 mg/l of the commercial detergent. The percentage survival and growth of larvae decreased significantly at 1.00 and 0.50 mg/l, respectively, for LAS and at 2.50 mg/l for the liquid detergent. Although growth of oyster larvae was decreased by concentrations of 100 ml per liter of effluent with or without LAS, the reduction was not drastic except at concentrations of 200 ml per liter or higher. The toxicity, if any, of the degradation products of LAS was masked by the toxicity of the effluent itself. (Sjolseth and Katz-Washington)
W70-06696

EVALUATION OF LAMPREY LARVICIDES IN THE BIG GARLIC RIVER AND SAUX HEAD LAKE,
Bureau of Commercial Fisheries, Marquette, Mich.
Patrick J. Manion.
Journal of the Fisheries Research Board of Canada, Vol 26, p 3077-3082, 1969. 2 tab, 1 fig, 7 ref.

Descriptors: *Ammocetes, *Larvicides, *Lampreys, Michigan, Fish control agents, Fish populations, Mortality, Census, Fish migration, Evaluation.
Identifiers: *Bayluscide, *TFM, *Petron marinus, Saux Head Lake, Michigan, Big G River, Synergism.

Bayluscide (5,2'-dichloro-4'-nitrosalicylan and TFM (3-trifluoromethyl-nitrophenol) evaluated as selective larvicides for control sea lamprey, Petromyzon marinus, in the Big G River and Saux Head Lake in Marquette Co Michigan. Population estimates and movem ammocetes were determined from the recapt marked ammocetes released before chemical ment. In 1966 the estimated population of ammocetes off the stream mouth in Saux Hea reduced 89% by treatment with granular B cide; this percentage was supported by a pe tion estimate of 120 ammocetes in 1967, dicated reduction of 96% from 1966. Postma movement of ammocetes was greater downstream. (Sjolseth and Katz-Washington)
W70-06697

5D. Waste Treatment Processes

DETERMINATION OF DEGRADED DYES AUXILIARY CHEMICALS IN EFFLU FROM TEXTILE DYEING PROCESSES,
Georgia Inst. of Tech., Atlanta. Environm Resources Center.
For primary bibliographic entry see Field 05A
W70-06316

MINE WATER RESEARCH: PLANT DE AND COST ESTIMATES FOR LIMES TREATMENT,
Bureau of Mines, Pittsburgh, Pa. Coal M Research Center.
Edward A. Mihok.
Bureau of Mines Report of Investigations April 1970. 13 p, 1 fig, 7 tab.

Descriptors: *Acid mine water, *Water po treatment, *Water pollution control, Waste treatment, Neutralization, Limestones, Ae Settling basins, Sludge.
Identifiers: Acid mine water treatment.

Plant design and cost estimates for limestone ment of acid mine water covering a wide ra quality and quantity conditions are presente treatment process consists of limestone neut tion, aeration, solids settling, and concent The design criteria for the various operatio tions are based on pilot plant performance, h tory data, and established mine water tre standards. Unit costs are assumed and are to general market prices and conditions. The mates serve as preliminary indicators of w would cost to construct and operate a mine treatment plant. (Knapp-USGS)
W70-06532

MASTER WASTEWATER COLLECTION TREATMENT PLAN FOR BOGOTA, CO BIA,
Kamp, Dresser, and McKee.
David R. Horsefield.
Journal Water Pollution Control Federatio 40, No 8, p 1443-1458, Aug 1968. 9 fig, 3 ref.

Descriptors: *Sewage treatment, *Pl *Design, Waste water treatment, Flows, Co tion, Costs, Treatment, Sewers.
Identifiers: *Bogota, Combined sewers, Loa

Bogota, the capital city of Colombia is loc the Andes Mountain plateau and has a pop of 1,700,000. The average waste water flow million gallons a day is expected to increase estimated 1985 population of 3,200,000. A plan is established recommending the const of sewers and canals to convey combined w points of treatment prior to discharge Bogota. The first stage program, ($11,000,

ntly is underway. The entire project will cost 00,000. Problems encountered and methods in design criteria are discussed. (Hancuff-Tex-

-06579

OSAL AND RECOVERY OF ELEC-PLATING WASTES,
n Carolina Univ., Chapel Hill.
ge E. Barnes.
al Water Pollution Control Federation, Vol o 8, p 1459-1470, Aug 1968. 10 fig, 5 tab.

riptors: *Industrial wastes, *Treatment, orination, Waste water treatment, Cost, ge treatment, Coatings, Metals, Waste water, ons.
ifiers: *Electroplating, Plating, Metal protec- Cyanides, Chemical removal, Recovery, In- survey.

uction and recovery are two major methods lectroplating waste disposal. Recovery de- ls more elaborate control of rinsing edures since the goal is to concentrate first rin- o the point where they can be returned to the ng baths as makeup. This can save money over ical treatment such as chlorination of the es. Other considerations to be made when ling between recovery versus destruction are g valves, pumps, accumulation tanks, chemi- orage and feeding equipment, controls, sludge ge tanks, tank trucks, and lagoons. The matter idge handling and lagooning in some localities be a serious deterent to adoption of the uction process. (Hancuff-Texas)
-06580

SATILITY AND EXPANDABILITY OF TREATMENT,
ford Univ., Calif.
Eliassen, and Dean F. Coburn.
nal of the Sanitary Engineering Division, E, Vol 95, No SA2, p 299-310, April 1969. 2 tab, 3 ref.

riptors: *Waste water treatment, *Water ment, Planning, Design, Treatment facilities, ation, Aeration, Screens, *Pre-treatment ter).
tifiers: Unit processes.

reatment processes are designed to precondi- water and waste water for subsequent opera- s. Processes for water include watershed agement, reservoir storage, screening, sand s, aeration, and chemical treatment. Pumps, s, grinding, grit removal and washing, preacra- , flotation, and chemical treatment are used for e water. The combination of processes varies each installation, but depends largely on the racteristics of the raw water and waste water the degree of treatment to be provided. ning and designing for pretreatment must be d on a detailed understanding of the processes their functions. A good design must meet the ediate and the future treatment objectives, and w for changes and future expansion in treat- t units and processes. (DiFilippo-Texas)
0-06581

MOVAL OF NEMATODES BY RAPID SAND TRATION,
ois Univ., Urbana.
ne Wen-Tung Wei, R. S. Engelbrecht, and John Austin.
rnal of the Sanitary Engineering Division, ceedings of the American Society of Civil En- eers, Vol 95, No SA1, February 1969, p 1-16, ig, 4 tab, 12 ref.

criptors: *Nematodes, *Filters, *Water pollu- , Worms, Filtration, Pre-treatment (Water), ste water treatment.
ntifiers: *Nematode removal, *Sand filters, tility, Filtration time, Sand size, Nematode ance, Hydraulic resistance.

Experimental methods have been adopted to obtain information on the mechanism of nematode removal by rapid sand filtration and to study the role of motility. In order to confirm the existing practice, effective sizes and uniformity coefficients were selected on the criterion for the preparation of sand. A filtration time of 8 hours was selected for most of the studies. The study reveals that with a low percent nematode motility, the removal of nematodes increases with decrease in sand size. The penetration of nonmotile nematodes increased as the hydraulic resistance of the filter decreased. It was further determined that most of the nematodes could penetrate the filter bed although they were temporarily retained in the sand during the early stages of filtration. These motile nematodes also cause serious dislodgement of the non-motile nematodes initially removed by the filter. The above two phenomena result in an overall decrease in the removal of nematodes. Chemical pre-treatment method could reduce the dislodging effect, but not very significantly. (Shankar-Texas)
W70-06582

EVALUATION OF ANAEROBIC DENITRIFICATION,
Metcalf and Eddy, Inc., Palo Alto, Calif.
D. F. Seidel, and R. W. Crites.
Journal of the Sanitary Engineering Division, Proceeding of the ASCE, Vol 96, No SA 2, p 267-277, April 1970. 7 fig, 1 tab, 8 ref.

Descriptors: *Anaerobic digestion, *Denitrification, *Filters, Pilot plants, Laboratory test, Anaerobic bacteria, Nitrates, Waste water treatment, Sewage treatment, Waste treatment.
Identifiers: Upflow, Horizontal flow, Media.

Several methods of removing nitrogen from sewage effluents by anaerobic denitrification were evaluated. An upflow anaerobic filter containing gravel media (1 in. to 1.5 in) was used to denitrify a municipal wastewater which contained an average of 14 mg/l nitrate nitrogen. Results obtained from pilot plant studies using methanol as a supplementary carbon source for the denitrifying bacteria showed 90% nitrogen removal with a detention time as short as 1.5 hours. Laboratory studies were also conducted utilizing upflow and horizontal flow filters containing a fiber media composed of a Dynel fiber coated with neoprene resin and bonded to a fiberglass mesh. This highly porous fiber media performed comparably to the gravel media in the upflow filter as 88% nitrate nitrogen removal was obtained with a detention time of 2 hours. However, media configuration and poor flow distribution limited the success of the horizontal flow filters. Several advantages of the anaerobic filter process for denitrification such as, low initial and operating cost, simplicity of operation, long solids retention times, and absence of any sludge recycle or disposal equipment were presented. The cost of methanol was the major operating expense for the process. The quantity of methanol required increases with increasing dissolved oxygen and nitrate nitrogen and decreasing effluent BOD. The total cost not including the cost of nitrifying the secondary effluent and reacrating the denitrified effluent was estimated as low as $12.00 per million gallons. (Galwardi-Texas)
W70-06583

AEROBIC BACTERIOLOGY OF WASTE STABILIZATION PONDS,
Oklahoma Univ. Medical Center, Oklahoma City. Inst. of Environmental Health.
J. D. Gann, R. E. Collier, and C. H. Lawrence.
Journal of the Water Pollution Control Federation, Vol 40, No 2, p 185-191, Feb 1968. 1 fig, 2 tab, 12 ref.

Descriptors: *Aerobic treatment, *Lagoons, *Microbiology, Bacteria, Dissolved oxygen, Microorganisms, Organic loading, *Waste water treatment.
Identifiers: *Bacteriology, *Experimental units, Achromobacter, BOD removal, Flavobacterium, Nitrogen reduction, Pseudomonas.

As assessed by morphological and physiological investigations, the flora of laboratory and field ponds consisted primarily of Gram-negative, rod-shaped bacteria generically identified as Achromobacter, Pseudomonas, and Flavobacterium. Together the members of these genera constituted 90 to 95% of the total count. The physical, chemical, and metabolic requirements of this group were found to be compatible with the temperature, variable DO, alkaline pH, and proteinaceous substrate found in stabilization ponds. Their reactions were found to be in agreement with the observations of pond characteristics and performance. Their occurrence in dominant proportions under a variety of operational conditions indicate that these organisms were primarily responsible for the treatment of domestic wastes in the stabilization ponds studied. The experimental waste stabilization ponds were operated at a loading of 30 lbs BOD/ac/d which resulted in an operational efficiency of 93% in BOD reduction. The greatest part of the treatment was achieved in the immediate vicinity of the influent. (Aguirre-Texas)
W70-06584

ANAEROBIC LAGOON TREATMENT OF MILKING-PARLOR WASTES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Raymond C. Loehr, and John A. Ruf.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 83-94, Jan 1968. 5 fig, 4 tab, 14 ref.

Descriptors: *Anaerobic conditions, *Industrial wastes, *Lagoons, Dairy industry, Animals, Biochemical oxygen demand, Coliforms, Efficiencies, Sewage treatment, Sludge, *Waste water treatment.
Identifiers: *Dairy cattle, *Field study, Milking parlor, Waste characteristics.

A field study of an 80-cow milking parlor and its waste treatment facilities determined that the average flow and BOD5 of the milking parlor waste were 760 gpd (2870 l/d) and 1030 mg/l. The flow varied considerably through the day. The first cell was loaded at 9 lbs BOD5/d/1000 cuft (144 g BOD5/d/cu.m). The summer BOD reduction was 85% while during the winter it was only 70%. The BOD5 of the supernatant from the second cell during the summer ranged from 50 to 100 mg/l. Removal of solids from the lagoons during cold weather adversely influenced the performance of the lagoons. Solids assumulated in the first cell during winter and were degraded during spring. Coliform reductions in the system exceeded 99%. (Aguirre-Texas)
W70-06585

MATERIALS OF CONSTRUCTION FOR TRADE WASTE TREATMENT PLANTS,
Prodorite Ltd., Birmingham (England).
For primary bibliographic entry see Field 08G.
W70-06586

SEWAGE PLANT DESIGNED FOR FLUCTUATING POPULATION,
Nebolsine, Toth and McKee, Fort Lee, N.J.
Arnold R. Smith.
Water and Wastes Engineering, Vol 7, No 1, p 40-41, Jan 1970. 3 fig.

Descriptors: *Design, *Aerobic treatment, *Construction costs, *Cost comparisons, *Treatment facilities, *Equipment, Aeration, Treatment, Waste water treatment, Sewage treatment, Settling basins, Activated sludge.
Identifiers: *Primary clarifiers, *Savings (Equipment and construction), *Aerobic digestion, *Contact stabilization, Duquesne (Penn), Duquesne Sanitary Authority (Penn), Contact chlorination, Recycling (Sludge), Re-aeration.

Plant design description is presented of a 2 mgd wastewater treatment plant at Duquesne, Pennsylvania. Design differs from conventional type; it provides for tanks one-third smaller than standard

size and the facilities using contact stabilization and aerobic digestion are adaptable to meet rapid, seasonal or fluctuating demands, such as encountered due to population changes in resort towns. Operational flexibility and construction savings are discussed. Other important departures from conventional treatment are: Primary settling is eliminated; and, the volatile content of sludge is reduced in order to dispose of its solids. The specific modifications in process and equipment design which pertain to these departures are described briefly. Equipment and space requirements are greatly reduced due to the smaller tanks and use of common wall construction for contact stabilization and aerobic digestion. The key to the low-cost operation is the series of 8 identical tanks (2 for contact aeration of raw sewage, 2 for sludge stabilization, 3 for aerobic digestion, 1 for standby); any tank can be used for any part of the process, and the number of tanks used can be varied to meet changing demands. The plant can be run at design capacity of 2 mgd or at any fraction thereof without loss of treatment efficiency. (D-'Arezzo-Texas)
W70-06587

BIOLOGICAL ASPECTS OF ORGANIC WASTE TREATMENT,
Bath Univ. of Technology (England).
R. G. Board.
Water Pollution Control, Vol 67, No 6, p 614-621, 1968. 4 fig, 2 tab, 38 ref.

Descriptors: *Bacteria, *Biological properties, *Organic wastes, *Microorganisms, Metabolism, Disposal, Incineration, Dispersion, Dilution, Oxidation lagoons, Activated sludge, Filtration (Biological), Fermentation, Oxygenation, *Waste treatment.
Identifiers: *Protocaryotic cell, *Eucaryotic cell, *Cell structure, *Cell function, *Organic waste treatment, *Microbial kinetics, Bacterial metabolism, Pseudomonads, Macro-organisms, Composting, Wet air oxidation, Violent agitation, Lagoons, Pasveer method.

A description is given of the structure and function of a bacterial cell typical of those that carry out waste degradation, and the suggestion is made that the kinetics of microbial growth should be given greater emphasis in the development of waste water treatment processes. The mechanics and metabolism of accepted disposal methods are examined, including: incineration, dispersion, separation, dilution, composting, oxidation ponds, lagoons, violent agitation, biological filters, and fermentation. In most organic waste treatment methods, micro-organisms, especially bacteria are agents of primary importance. Major structural properties of the bacterial (protocaryotic) cell are described and contrasted with plant and animal (eucaryotic) cells. Functional physiological similarities of cells are explained. While the kinetics of microbial growth has experienced major advances in micro-biology, the full benefits of this knowledge has not been realized in the design and operation of waste treatment plants. However, while with one organism growing in a defined medium, the kinetics of growth can be established with a fair degree of accuracy, this information is of limited value when confronted with heterogeneous bacterial populations exposed to an undefined and variable supply of nutrients. This fact compels extensive laboratory tests before practical modifications can be made in plant and operational procedures. (D'Arezzo-Texas)
W70-06588

THE CONTROL AND TREATMENT OF TRADE EFFLUENTS,
Greater London Council, London (England).
John Griffiths.
Water Pollution Control, Vol 67, No 6, P 606-611, 1968.

Descriptors: *Effluents, *Control systems, *Treatment, *Industrial wastes, Industries, Disposal, Pretreatment (Wastes), Solid wastes, Costs.
Identifiers: *Trade effluents, *Food factories, *Treatment charges, *Mogden-type cost treatment formula, pH control, Solids removal, Lime, Soda ash, River authority.

Needs, means, and principles of treatment and control of food factory effluents are discussed. Satisfactory degrees of control mentioned were: solids removal up to 1500 mg/l, pretreatment of grease, and oil, pH control by lime or soda ash addition to acid discharge, and provision of petrol/oil interceptors. The imposition of charges by a local authority for the treatment of trade effluents is discussed. The so-called 'Mogden-type' formula for determining the cost of treatment has encountered considerable difficulty in actual applications. It cannot be applied equitably to both small and large industries. Also, insofar as types of industries are concerned the formula is troublesome to apply. Special discussions ensued by symposia attendees regarding emphasizing problems created by the wide variation in trade effluents, the efficacy of treatment and, the relative merits of the Modgen-type cost formula. The trend is toward seeking a rational basis for treatment cost imposed on industry. (D'Arezzo-Texas)
W70-06589

A REVIEW OF POULTRY WASTE DISPOSAL POSSIBILITIES,
Ministry of Agriculture, Fisheries and Food, London (England).
For primary bibliographic entry see Field 05E.
W70-06590

FARM WASTE DISPOSAL IN RELATION TO CATTLE,
National Agricultural Advisory Service, London (England).
For primary bibliographic entry see Field 05E.
W70-06591

REVERSE OSMOSIS OFFERS USEFUL TECHNIQUE FOR DESALTING,
Office of Saline Water, Washington, D.C.
K. C. Channabasappa.
Water and Wastes Engineering, Vol 7, No 1, p A5-A8, Jan 1970. 3 fig, 3 tab.

Descriptors: *Osmosis, *Membrane process, *Desalination, *Municipal wastes, *Industrial wastes, Industrial water, Agriculture, Sewage treatment, Water supply, Water reuse, Water demand.
Identifiers: *Reverse osmosis, *Membrane technology, *Costs (Treatment), *Costs (Water), *Capital costs, *Plant designs, *Waste reuse economics, By-product recovery, Quality standards (Effluents), Brackish water analysis.

Two potential sources from which future industrial and agricultural water needs can be obtained are municipal sewage and industrial wastes. Formerly, the high cost of treatment of these sources precluded reuse. With the osmosis process, however, both municipal and industrial wastes can be treated to provide industrial water at 25 to 35 cents/1000 gals. Expected advances in membrane technology in the next 5 years may lower costs to 15-20 cents/1000 gals. Whether it is economical to get additional industrial water by desalination of sewage or industrial wastes or both must be based on: (1) cost and availability of alternate water sources; (2) actual cost of treating sewage or industrial wastes by desalination processes; (3) the value of by-product recovery; (4) cost savings accruing from lesser volumes of wastes to be discharged. The prospects and potentialities of desalination of wastes to obtain additional water for industrial and agricultural uses, warrant closer study as water demands increase and effluent water quality standards become more stringent. (D'Arezzo-Texas)
W70-06592

TECHNOLOGIES IN COAGULATION,
Bissell, Bronkie and Associates, Williamsville, N.Y.
William H. Merrill, Jr.
Water and Wastes Engineering, Vol 7, No 1, p 43, Jan 1970. 2 p.

Descriptors: *Coagulation, *Zeta potential, *Fl culation, *Treatment, *Wastes, *Waste wa disposal, Sedimentation, Adsorption, Viscosity, tration.
Identifiers: *Flotation, *Chemical treatment, *F formation, *Settling, *Polyelectrolytes, Neutrali tion of electric charges, Organic coagulants, ganic chemicals, Electrical field, Sludge thick ing, Pollution abatement.

The processes of coagulation or flocculation explained to insure a more basic understanding the engineer in his application of these processe wastewater control. Coagulation may be c sidered as a chemical treatment differing fr purely physical or biological treatments. Howe this distinction cannot be adhered to rigorou since the three enumerated treatments are practically separable in the comprehensive tr ment process. The study explains the practical jo usages of coagulation and sedimentation. Seve mechanisms involved in coagulation are explai including: settling of precipitates and entrapm of material, neutralization of electric charges, floc formation. The various chemicals norm used in coagulation are identified and evaluat The use of organic chemicals to effect coagulat is relatively new. Various types are described evaluated, including: non-ionic binder ty polyelectrolytes of the polymeric type. The r tively higher costs and special problems created polyelectrolytes are explained. Certain special u of coagulation are explained, notably: flotati sludge thickening and filtration. New techniq based on more effective application of the Z potential concept are feasible. It is now possibl measure the potential and use the measurem for improving coagulation. (D'Arezzo-Texas)
W70-06593

SLUDGE TREATMENT AND DISPOSAL THE BROCKHURST WORKS OF THE UPP TAME MAIN DRAINAGE AUTHORITY,
Upper Tame Main Drainage Authority, mingham (England).
B. R. Edmondson.
Water Pollution Control, Vol 68, No 2, p 146-1 March-April, 1969. 11 fig, 7 tab, 1 ref.

Descriptors: *Sludge disposal, *Costs, Li Design, Operations.
Identifiers: *Polyelectrolytes, *Press plant, *Slu conditioning, Copperas.

The Brockhurst works handles a 6.25 mgd weather flow, of which 2.25 mgd is trade efflue A sludge pressing plant was installed to supplem drying beds and lagoons. The plant was designe handle 122,500 gallons of digested sludge cont ing 4.5 percent dry solids and 192,500 gallon primary and humus sludges containing 6.0 perc dry solids during a five day week. Descriptio given concerning the design and operation of plant which utilizes lime and copperas as conditi ing agents. Prior to installation of the p Buchner-funnel tests were run using lime and c peras, and aluminum chlorohydrate as condition agents. Lime and copperas was found to be most effective. This result was verified by t using a 12 inch square, single plate press. Tw nine polyelectrolytes were also investigat Several polyelectrolytes reduced the specific sistance to an acceptable level but only two three were competitive in cost. None of polelectrolytes was sufficiently effective digested sludge and two reagents were effective humus sludge. Data are presented on the p formance of several polyelectrolytes. Capital operational cost data are given. (DiFilippo-Texa
W70-06594

EXPERIENCE WITH A WAGE INCENT BONUS SCHEME AT GOSCOTE A BROCKHURST SEWAGE WORKS,
For primary bibliographic entry see Field 06C.

70-06595

LE OF ACTIVATED SLUDGE FINAL SET-ING TANKS,
nois Univ., Urbana. Dept. of Civil Engineering.
chard I. Dick.
rnal of the Sanitary Engineering Division, CE, Vol 96, No SA2, p 423-436, April 1970. 10 , 17 ref.

scriptors: *Activated sludge, Sewage treatment, dimentation, *Waste water treatment.
ntifiers: *Thickening, *Final settling tank, *Flux e, Clarification, Suspended solids.

e final settling tank in the activated sludge ocess has two functions: clarification and ckening. Conventional design procedures have nsidered only the clarification function. How-er, inadequate performance of thickening func-ns produces adverse effects, including: loss of spended solids to the effluent and insufficient spended solids concentration in the sludge recy- which leads to lower mixed liquor suspended ids concentrations in the aeration tank. To as-re proper performance of the final settling tank e tank should be sized for each function and the ger size should govern the design. The area quired for thickening must be sufficient so that ids are applied to the tank at a rate less than the e at which solids are able to reach the bottom of e tank. The rate at which biological solids reach e bottom of the tank is termed the flux rate. haracteristically, this flux rate passes through a nimum for some concentration of activated dge present in the settling tank. This minimum x rate acts as a bottleneck and governs the area quired for thickening. Several methods for deter-ning the limiting capacity are given in an illustra-e example. (DiFilippo-Texas)
70-06596

FFECT OF DISSOLVED OXYGEN CONCEN-RATION ON THE METABOLIC RESPONSE F COMPLETELY MIXED ACTIVATED LUDGE,
klahoma State Univ., Stillwater. Dept. of Civil ngineering.
J. Tharbaraj, and A. F. Gaudy, Jr.
urnal of the Water Pollution Control Federation, ol 41, No 8, Part II, p R322-R335, August, 1969. ig, 3 tab, 29 ref.

escriptors: *Activated sludge, *Dissolved oxygen, hemical oxygen demand, Sewage treatment, etabolism, Waste water treatment.
entifiers: *Shock load, Transient behavior, eady state.

eady state conditions were established in labora-ry activated sludge units at specific levels of dis-lved oxygen (7.2, 7.4, 3.2, and 1.3 mg/l), the ncentration of substrate in the feed was in-eased, observation was made of the transient and ew steady state behavior, and in some cases sub-rate concentration was reduced to the original vel and observation made of the transient and ew steady state. Steady state valves of respiration te, substrate channelled into respiration, solids eld, COD removed per weight of ammonia con-med, and protein and carbon-hydrate concentra-on of cells were found to be independent of dis-lved oxygen concentration in the range studied .4 to 7.4 mg/l). The transient response consisted two distinct sequential responses. The first was a etabolic or physiological reaction carried out by e population present prior to the shock. During is initial response lower dissolved oxygen levels ave rise to higher COD in the effluent. The second ansient response involved a change in the redominate population; gave rise to increased OD, solids and intermediates in the effluent, and as independent of dissolved oxygen concentra-on. (DiFilippo-Texas)
70-06597

OXYGEN DEMAND AND SUPPLY IN AN ACTIVATED SLUDGE PLANT,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
K. L. Schulze, and R. D. Kooistra.
Journal of the Water Pollution Control Federation, Vol 41, No 10, p 1763-1774, October 1969. 12 fig, 11 ref.

Descriptors: *Activated sludge, *Oxygen requirements, *Aeration, Biochemical oxygen demand, Sewage treatment, Dissolved oxygen, *Waste water treatment.
Identifiers: Oxygen uptake rates.

Mixed liquor oxygen consumption rates, r sub r, specific oxygen consumption rates, K, and BOD of primary effluent were measured during the fall and summer academic terms at the first bay of a three-bay activated sludge aeration tank series. Hourly and daily fluctuations in both r sub r and K sub r were quite similar to fluctuations in BOD. The similarity of fluctuations of r sub r and K sub r indicated that changes in r sub r essentially were caused by changes in the physiological activity of the floc and not simply changes in mixed liquor suspended solids concentration. While oxygen uptake rates of 9 mg/l/hr to 42 mg/l/hr and 32 mg/l/hr to 90 mg/l/hr were observed during the summer and fall respectively, aeration equipment was found capable of providing dissolved oxygen at a rate of 22.5 mg/l/hr. Thus the aeration equipment acted as a limiting factor and slowed down the process. It is concluded that for a relatively inflexible and low rate oxygen supply, as provided by most aeration equipment, it would be advantageous to strive for complete mixing conditions. (DiFilippo-Texas)
W70-06598

KINETICS OF OXYGEN UPTAKE BY DEAD ALGAE,
Howard Univ., Washington, D.C. Dept. of Civil Engineering.
Man M. Varma, and Francis DiGiand.
Journal of the Water Pollution Control Federation, Vol 40, No 4, p 613-626, April 1968. 11 fig, 6 tab, 16 ref.

Descriptors: *Age, *Algae, *Biodegradation, *Oxygen demand, Laboratory tests, Lagoons, Oxidation, Photosyntheses, Plants, Temperature, *Waste water treatment.
Identifiers: *Uptake, Cells, Concentration, Composition, Material balances, Organisms.

The rate of oxygen uptake by dead algal cells is independent of the algal cell concentration. The rate of uptake by young cells is greater than that by old cells. Rates increase with temperature up to about 35 deg C, then decrease sharply. Increased bacterial population will increase the biodegradation of the dead algae. Uptake rates observed ranged from 0.008 micro l 0 sub 2/min/mg algae for old cells at 20 deg C to 0.294 micro l 0 sub 2/min/mg algae for young cells at 35 deg C. Material balances showed that the total actual oxygen uptake was less than the total oxygen required for complete degradation of the substrate because oxidation was incomplete. (Aguirre-Texas)
W70-06600

OVERLOADED OXIDATION PONDS--TWO CASE STUDIES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Ross E. McKinney.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 49-56, Jan 1968. 9 tab, 7 ref.

Descriptors: *Aeration, *Algae, *Lagoons, *Oxidation lagoons, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen, Odor, Organic loading, *Waste water treatment.
Identifiers: *Aeration tubes, *Diffusers, *Raytown (Mo), Lee's Summit (Mo), Oxygen transfer, pH, Suspended solids.

The use of a diffused aeration system as a means of increasing the capacity and improving the performance of overloaded oxidation ponds was evaluated in a one year dual study of the ponds at Lee's Summit and Raytown, Mo. The supplemental aeration system consisted of polyethylene tube diffusers, a common header, and an air compressor. Data accumulated during the test period include BOD, COD, suspended solids, pH, and dissolved oxygen. Biochemical oxygen demand (BOD) and COD removal averaged 80% and 54% at Lee's Summit, respectively. The pond covered 25 acres, with an average depth of 5 feet and an average detention period of 30 days. The BOD5 load to the pond was estimated to be 2550 lbs/day. The oxidation pond at Raytown consisted of a first-stage aerated lagoon with two 15-HP aerators followed by a second-stage lagoon, where the plastic aeration tubing was installed, estimated to receive an organic load of 1000 lbs BOD5/day. Organic removal efficiencies were similar to the Lee's Summit system as a statistical basis. The plastic tubing aeration units can produce an effluent under 30 mg/l BOD5 at a loading of 1000 people/d/ac. But, the study indicates that the aeration tubing should be used with caution. It can assist overloaded oxidation ponds by improving mixing, but is not a cure-all. Clogging of the aeration tubing was a problem relieved by treatment with hydrochloric acid, and the basic mechanism of treatment was increased algal metabolism through better mixing rather than direct oxygen transfer. (Aguirre-Texas)
W70-06601

REGIONAL MANAGEMENT OF WATER QUALITY--A SYSTEMS APPROACH,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
Melvin W. Anderson, and H. J. Day.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1679-1687, Oct 1968. 4 fig, 1 tab, 8 ref.

Descriptors: *Management, *System analysis, *Sewage treatment, *Computers, *Dissolved oxygen, Analysis, Biochemical oxygen demand, Costs, Operational costs, Planning, Streams, Water Pollution Control, *Waste water treatment.
Identifiers: *Miami River (Ohio), Stream pollution.

A modified Streeter Phelps Equation was adapted to linear programming to study ways of minimizing regional operation costs for a number of waste water treatment plants on a river subject to water quality standards. The region studied was a warm Miami River valley in Ohio from Dayton to New Baltimore. The parameters considered in the optimization technique are: (1) number and length of reaches and location of waste outfalls, (2) waste loadings received by treatment facilities, (3) treatment available at each outfall, (4) operating cost of each waste treatment facility, (5) quantity and quality of tributary flows, (6) deoxygenation coefficients, (7) reoxygenation coefficients, (8) velocity of river in each reach, (9) temperature of river in each reach, (10) river standards of desired level (DO), and (11) initial conditions of river prior to first reach. Results indicate that higher dissolved oxygen levels in a river can be obtained at reduced operating costs. It is also possible to suggest where future waste water treatment facilities should be located to obtain maximum benefits. (Hancuff-Texas)
W70-06602

BIOLOGICAL EXTRACTION OF NUTRIENTS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
Jack A. Borchardt, and Hardam S. Azad.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1739-1754, Oct 1968. 13 fig, 22 ref.

Descriptors: *Algae, *Phosphorus, *Phosphates, Energy, Di-urnal distribution, Temperature, Metabolism, *Waste water treatment, Light, Microorganisms, Plants.

Identifiers: *Biological extraction, Growth, Shock loading.

Studies of phosphate uptake from synthetic secondary waste water by algae in continuous-culture laboratory units showed three regimes of phosphate uptake: (1) growth dependent on phosphate concentration below 0-1.5 mg/l phosphate (0-3% of algal dry weight), (2) storage of phosphate at 1.5 to 4.5 mg/l (3-9%), and (3) saturation at phosphate levels greater than 4.5 mg/l (9%), at an organism density of 50 mg/l. At 15 mg/l the growth rate also declined when phosphate concentration was lowered beyond 3% of the algal dry weight. As temperatures become lower, higher phosphate concentrations were needed to grow the same mass of protoplasm. About two-thirds of the phosphate uptake achieved under constant light conditions is achieved under a di-urnal type light cycle. After shock loading phosphate starved cultures can exhibit phosphate uptakes of up to 20% by weight. (Hancuff-Texas)
W70-06604

STATISTICAL COMPARISON OF TRICKLING FILTER EQUATIONS USING PAPER MILL EFFLUENT DATA,
Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
Peter G. Robertson, P. David Wilson, and Jon C. Liebman.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1764-1788, Oct 1968. 3 fig, 17 tab, 19 ref.

Descriptors: *Trickling filters, *Mathematical models, *Statistics, Biochemical oxygen demand, Industrial waste, *Waste water treatment.
Identifiers: *Paper mill wastes, Data, Analysis.

The trickling filter design equations of the National Research Council, Rankin, Velz, German, Stack, Schulze, Fairall, and Galler and Gotaas were evaluated for their ability to predict filter performance as calculated from observations taken from various craft and boxboard industry sources. Each observation included such readily measureable variables as BOD influent and effluent concentration, recirculation ratio, hydraulic loading, temperature, filter depth, and media configuration. Regression analysis was used to fit the parameters of these equations to the paper mill data. The residual variations for the fitted models were compared with those of the models using the previously published parameters. The least means square errors (MSE) between the observed and predicted filter performance was provided by the Galler and Gotaas equation. (Hancuff-Texas)
W70-06605

BOD REDUCTION BY CHLORINATION,
Florida Univ., Gainesville. Dept. of Bioenvironmental Engineering.
Russell H. Susag.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R434-R444, Nov 1968. 8 fig, 2 tab, 7 ref.

Descriptors: *Biochemical oxygen demand, *Chlorination, Aerobic treatment, Chemical oxygen demand, Costs, Dissolved oxygen, Waste water treatment, Effluents.
Identifiers: Deoxygenation constant.

The effect of chlorination on deoxygenation behavior was investigated in waste waters and treatment process effluents. Reduction in BOD values was observed on chlorination. What was more significant, however, was the retardation in BOD exertion as demonstrated by a reduction in the deoxygenation constant K. Several tests were conducted employing raw waste water as the test substrate with chlorine dosages varying from 5 to 40 mg/l and chlorine contact time varying from 30 to 60 minutes. At a chlorine dose of 10 mg/l the K value was determined to be 0.143 while the nonchlorinated sample showed 0.195. A comparison between effluent chlorination and additional treatment processes indicated that annual costs for effluent chlorination would be only 8 to 40% of the costs for the additional treatment providing operation periods totalled not more than 52 days annually. The extremely high daily operation costs indicated that the use of this method is limited as a process operation to a non-regular basis. This example indicates that effluent chlorination has a practical application when employed as a supplement to reasonable waste water treatment for the maintenance of desired dissolved oxygen levels at adverse receiving river dilution conditions. (Hancuff-Texas)
W70-06606

THE ROLE OF NITRATE NITROGEN IN BIOOXIDATION,
California Univ., Davis. Dept. of Civil Engineering.
E. D. Schroeder, and A. W. Busch.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R445-R459, Nov 1968. 10 fig, 41 ref.

Descriptors: *Nitrates, *Denitrification, *Aerobic treatment, *Anaerobic treatment, Pilot plant, *Waste water treatment.
Identifiers: *Biooxidation, *Glycolysis, *Krebs cycle, Hydrogen acceptor.

Bacterial reduction of nitrate has been a subject of importance to engineers for many years. An analysis of previous work indicates that little is known of what happens after nitrate is added to a treatment process. It is the purpose of this work to test three environments, aerobic, anaerobic with nitrate, and anaerobic without nitrate--using a bacteria inoculum in a glucose and mineral nutrient system. Results indicate that glycolysis in anaerobic systems using nitrate as a terminal hydrogen acceptor occurred at a faster rate than for other systems, carbon removal rates were lower; and acclamation procedures did not effect the similatory nitrate reduction. A reaction model for the glyclosis-Krebs cycle is set up to describe the three environments. (Hancuff-Texas)
W70-06607

KINETICS OF FIXED FILM BIOLOGICAL REACTORS,
West Virginia Pulp and Paper Co., Covington.
Billie H. Kornegay, and John F. Andrews.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R460-R468, Nov 1968. 3 fig, 1 tab, 7 ref.

Descriptors: *Kinetics, *Trickling filters, *Films, Biological treatment, Pilot plant, Design, Mathematical model, Microorganisms, *Waste water treatment.
Identifiers: *Monod equation, Continuous culture.

A mathematical model based on continuous culture theory has been derived and experimentally varified for microorganisms which grow attached to surfaces. Although the model is not intended to serve as a mathematical approximation of the trickling filter processes, the basic principles illustrated should serve as a foundation in establishing a rational method of design. The continuous function is obtained which describes the rate of substrate removal (glucose used in experiments) from essentially 0 order at high concentrations of substrate to first order at lower concentrations. The completely mixed liquid phase utilized in the experiment was maintained at a pH of 6.5 plus or minus 0.1 and a temperature of 25 plus or minus 0.5 deg C. The dissolved oxygen (DO) concentration varied from approximately 6 to 9 mg/l. The need for a model of this nature is most evident in the design of deep trickling filters. (Hancuff-Texas)
W70-06608

GRAPHICAL ANALYSIS OF BATCH CULTURE DATA USING THE MONOD EXPRESSIONS,
W. E. Gates, and J. T. Marlar.
Journal of the Water Pollution Control Federati
Vol 40, No 11, Part 2, p R469-R476, Nov 196
fig, 8 ref.

Descriptors: *Kinetics, *Mathematical mod
Data collection, Pilot studies, *Waste water tr
ment, Chemical oxygen demand, Biological oxy
demand.
Identifiers: *Monod equation, *Graphical analy
Analysis-systems, Continuous culture systems,
systems.

The applicability of the Monod equations to
analysis of biological waste water treatm
systems has been developed. The extent of its
depends on ease, adequacy, and economics of
collection and analysis. Monod equations re
easily to continuous systems; however, ba
systems have been difficult to study in this man
In an attempt to facilitate the use of Monod eq
tions for batch systems, a graphical method
been developed. Nutrients or organism data ma
used; however, both methods require some m
sure of viable bio-mass (the authors establishe
correlation between mass concentration
dehydrogenase activity which allows bio-mass
culation). Data show that constants
hydrodynamic properties for batch and continu
systems are transferable. (Hancuff-Texas)
W70-06609

**THE EFFECT OF STERILIZATI
TECHNIQUES ON WASTE WATER PROP
TIES,**
Toronto Univ. (Ontario). Dept. of Civil Engin
ing.
P. H. Jones, and D. Prasad.
Journal of the Water Pollution Control Federat
Vol 40, No 11, Part 2, p R477-R483, Nov 196
fig, 2 tab, 29 ref.

Descriptors: *Bacteria, *Effects, *Autoclaves,
radiation, Water properties, Physical propert
Chemical properties, Heat and Gamma R
Waste water treatment.
Identifiers: *Sterilization.

Two methods of sterilization--autoclaving
radiation--were tested on waste water. The
toclave was operated at conventional temperat
and pressure while radiation doses were se
500,000 to 3,000,000 rads. Pure cultures
Arthrobacter globiformis and Pseudomo
fluorescens were the tested microorganisms.
physical and chemical changes brought about
heat sterilization are significantly greater
those caused by irradiation. From the biolog
growth studies, the physical changes have a
siderable effect on the growth and behavior of
tain indigenous waste water bacteria. Thus, for
pure culture or for sterile studies utilizing w
water as a medium more realistic data will be
tained if the waste water is subjected to ioni
radiation rather than autoclaving as a means
sterilizing. (Hancuff-Texas)
W70-06610

**A CRITICAL VIEW OF SPECTRO METH
FOR WATER QUALITY CONTROL,**
Department of Water and Power, Los Ang
Calif.
For primary bibliographic entry see Field 05G.
W70-06611

**COMBINED INDUSTRIAL AND DOMES
WASTE TREATMENT IN WASTE STABILI
TION LAGOONS,**
Federal Water Pollution Control Administrat
Grand Forks, N. Dak.
Otmar O. Olson, W. Van Van Heuvelen, and Jo
W. Vennes.
Journal of the Water Pollution Control Federat
Vol 40, No 2, p 214-222, Feb 1968. 2 fig, 8 ta
ref.

riptors: *Biochemical oxygen demand, *Effi-ies, *Lagoon, Chemical oxygen demand, orms, Freezing, Photosynthetic bacteria, Sta-ation, *Waste water treatment.
ifiers: *Grafton (N Dak), *Meat processing es, *Milk processing wastes, *Potato essing wastes, Suspended solids, Total bac-

lization lagoons are used extensively in North ota as a means of treating domestic wastes. eloping industries have been discharging their es to the local municipalities lagoon and cause lems. Existing design standards recommend an nic loading rate of 20 lbs BOD5/acre/day with isions for 120 days retention. During the ner months, lagoon efficiency indicated that ngs of 200 lbs BOD5/acre/day could be ap- during these periods. The application of to wastes as well as meat processing and milk es to municipal stabilization lagoons can ate the loading to over 250 lbs BOD5/acre/day lting in severe nuisance conditions during the g thaw period. Purple sulfur bacteria develop ly in overloaded lagoons as the temperature is ated beyond 45 deg F (72 deg C) and anacro-decomposition of the settled solids promotes production of hydrogen sulfide (H2S). In-plant ment of the food processing industry is essen- to remove the settleable solids prior to harge to a lagoon. The suspended solids are a or in lagoon loading as they tend to drop out ng the winter freeze. (Aguirre-Texas)
0-06612

STE WATER TREATMENT FOR THE RNS HARBOR PLANT OF BETHLEHAM EL CORPORATION,
leham Steel Corp., Chesterton, Ind. Burns bor Plant.
. Leidner.
rnal of the Water Pollution Control Federation, 41, No 5, Part I, p 796-807, May 1969. 18 fig.

criptors: *Activated sludge, *Oil, Skimming, aste water treatment, Industrial wastes.
tifiers: *Steel waste discharge, *Acid waste, ondary waste treatment, Primary treatment, gulant aid, Deep-well injection, Mill wastes, culator-Clarifier, pH.

Burns Harbor plant of the Bethleham Steel poration has a complex waste water treatment lity for all contaminated waste water. The initial gn of water and waste water systems included gn parameters such as (1) the reuse of process er whenever possible, (2) the segregation of tes to facilitate treatment, (3) the primary tment of wastes when required to protect sewer ems, and (4) terminal treatment of all con-inated waste prior to discharge. A study of lifications made to the wastewater systems, in ration since 1964, is also included. pH monitor- deep-well injection piping materials, and gulant aids were all changed. The activated ge unit 0.47 mgd has operated satisfactorily er varied conditions of operation. The Burns bor plant is in the process of expanding to an in-ated steel mill. (Shankar-Texas)
0-06614

TER AND WASTE WATER, WATER POL-TION CONTROL IN AUSTRALIA,
tropolitan Water, Sewage and Drainage Board, ney (Australia); New South Wales Univ., sington (Australia).
primary bibliographic entry see Field 05G.
0-06615

IPLIFIED MATHEMATICAL PROCEDURE R DESIGNING POST AERATION SYSTEMS,
Chainbelt, Inc., Milwaukee, Wis. Process ipment Div.
primary bibliographic entry see Field 05G.
0-06616

INDUSTRIAL WATER MANAGEMENT AT CHRYSLER CORPORATION,
Chrysler Corp., Detroit, Mich. Product Planning and Development.
Alvin R. Balden.
Journal of Water Pollution Control Federation, Vol 41, No 11, Part I, p 1912-1922, Nov. 1969. 11 fig, 3 tab.

Descriptors: *Water management, *Industrial wastes, Oil-wastes, Biochemical oxygen demand, Incineration, Sludge-disposal, Water conservation, *Waste water treatment.
Identifiers: *Air floatation, *Chemical costs, Sedimentation tanks, Drum skimmer.

The paper emphasizes the treatment of oily wastes from industrial waste water. A general review of Chrysler Corporation's experience since the early 1950's is presented. This involves separation of free oil and settleable solids in the primary tanks followed by adsorbtion of oil and particulates on an alum floc and a final polishing of the effluent by sedimentation. Finally incineration is accomplished in the incineration unit by forming a turbulent flame and atomizing the waste materials on to this flame. The disadvantages of this process are also included. Manpower requirements for treatment facilities and chemical costs are reported for the Trenton engine plant. In addition problems experienced with regard to disposal of the oily scum removed from the waste water are reviewed. Potential solutions are discussed. (Shankar-Texas)
W70-06617

RECONSTRUCTION OF OFFERTON SEWAGE WORKS OF HAZEL GROVE AND BRAMHALL UDC,
J. Morton, and F. Summerfield.
Water Pollution Control, Vol 68, No 1, p 85-92, Jan-Feb. 1969. 1 fig, 4 tab, 4 ref.

Descriptors: *Design, *Population, Activated sludge, Automatic control, Disposal, Dissolved oxygen, Costs, *Waste water treatment.
Identifiers: *Sedimentation tank, *Storm tank, *Biological filter, Dry-weather flow, Secondary treatment, Critical path analysis.

The extension of Offerton sewage works to meet treatment requirements in 1980 is discussed. The design is based on a 1980 population of 47,250 persons and a dry-weather flow 2.73 mil gal/d. The design proposals include a new mechanically-raked fine screen, two new storm tanks which will be cleaned by a transferable scraper operating in conjunction with transverse sludge concentrations at the inlet end, and a screw pump for returning the contents of the storm tanks for full treatment. Additional sedimentation capacity will be provided by two 65 ft. dia. and 14 ft. deep tanks. Secondary treatment of sewage will include a simplex surface-aeration plant incorporating six high-intensity cones. Automatic controls for monitoring DO, suspended solids and control of activated sludge return and of sludge blankets in final separating tanks will also be installed. Site investigations were carried out to estimate the cost of extensions. A critical path diagram for pre-constructional events is also presented. (Shankar-Texas)
W70-06618

STABILIZATION OF DAIRY WASTES BY ALGAL-BACTERIAL SYMBIOSIS IN OXIDATION PONDS,
Alexandria Univ. (Egypt). High Inst. of Public Health.
F. M. El-Sharkawi, and S. K. Moawad.
Journal of the Water Pollution Control Federation, Vol 42, No 1, p 115-125, January 1970. 4 fig, 5 tab, 17 ref.

Descriptors: *Dairy industry, *Oxidation lagoons, *Pilot plants, Algae, Biochemical oxygen demand, Biological treatment, Photosynthesis, Stabilization, *Waste water treatment, *Farm wastes.
Identifiers: *Alexandria (Egypt), Pandorina, Soluble organic solids.

A pilot-plant study of BOD reduction of milk processing wastes is reported. A synthetic dairy waste of 750 mg/l BOD was fed continuously to rectangular concrete basins with sloping sides to minimize sludging. The detention period was 10 days. An influent pH of 9.8 was maintained to keep the pH at a level conducive to algal growth. Tank depth was important in maintaining balance between the algal and bacterial fractions of the system. The microflora showed plasticity in adapting to environmental variations. Pandorina constituted a major member of the flora highly adaptable to interaction with dairy wastes. Pandorina could tolerate wide temperature variations (11 deg to 32 deg C) at a constant depth of 75 cm. Other organisms were responsive to specific conditions and when the dominant groups suffered a serious setback, the subdominants flourished. Biochemical oxygen demand (BOD) reductions were 80 to 90 percent at a BOD loading rate of 220 lbs/acre/day (246 kg/dia/day). (Aguirre-Texas)
W70-06619

FIELD EVALUATION OF THE PERFORMANCE OF EXTENDED AERATION PLANTS,
Cincinnati Univ., Ohio. Dept of Environmental Health.
J. David Eye, David P. Eastwood, Fernando Requena, and David P. Spath.
Journal of the Water Pollution Control Federation, Vol 41, No 7, p 1299-1318, July 1969. 20 fig, 19 ref.

Descriptors: *Activated sludge, *Biochemical oxygen demand, *Sewage treatment, *Aeration, Sludge, Nitrogen, Phosphorus, Operations, *Waste water treatment.
Identifiers: *Extended aeration, *Suspended solids, Detention time, Clarifier.

Five extended aeration plants with design flows of 30,500 to 90,000 gpd were studied over a three year period. Variables controlled at various plants included: ratio of actual to design detention times, time of aeration and solids loading. Experimental data included: solids, BOD, COD, nitrogen, phosphates, sludge volume index, pH, temperature, DO and oxygen uptake rates. Studies showed effluent BOD and suspended solids to be closely related. Therefore, the overall performance as measured by effluent quality of the extended aeration plants studied depended mainly on the ability of the system to retain suspended solids and the performance could be enhanced either by enlarging the clarifier or including a sludge wasting step. Considerable reduction in nitrogen was achieved by control of the quantity of air supplied. No net reduction in phosphates was observed. Almost continuous operational control was necessary to insure adequate operation, the most frequently encountered problems being associated with the sludge collecting and return mechanisms. (DiFilippo-Texas)
W70-06620

RESPONSE OF ACTIVATED SLUDGE TO ORGANIC TRANSIENT LOADINGS,
Associated Water and Air Resources Engineers, Inc., Nashville, Tenn.
Carl E. Adams, Jr., and W. Wesley Eckenfelder, Jr.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No. SA2, p 333-352, April 1970. 20 fig, 7 tab, 7 ref.

Descriptors: *Activated sludge, *Organic loading, *Oxygen requirements, *Kinetics, Domestic wastes, *Industrial wastes, Turbidity, *Domestic wastes, *Waste water treatment.
Identifiers: *Transient loading, Endogenous respiration, Synthetic waste, Settling characteristics.

Three wastes; synthetic, industrial and domestic; were treated in laboratory activated sludge units. The units were subjected to transient organic loadings. Settling characteristics, effluent quality, oxygen requirements, and sludge build-up were

monitored and visual and microscopic evaluation made. Results showed the Kinetic model, q % K sub l s sub e, which expresses removal as a function of growth limiting substrate remaining in solution, to apply satisfactorily to both steady and transient state conditions. The average removal rate coefficient, K sub l, appeared to increase under most transient conditions. This increase was possibly due to changes in organism population. The conventional oxygen utilization model was found to predict the oxygen requirements for steady as well as transient state conditions. The endogenous rate of oxygen uptake increased under transient conditions. The turbidity of the effluent increased with an increase in the average organic loading. Employing the synthetic substrate, it was found that activated sludge systems can tolerate up to three times the normal loading for 12 hours per day for several days without showing any significant increase of effluent soluble organic matter. (DiFilippo-Texas)
W70-06621

EFFECTIVE CHEMICAL TREATMENT FOR INHIBITION OF ANAEROBIC SEWAGE SLUDGE DIGESTION DUE TO ANIONIC DETERGENTS,
Water Pollution Research Lab., Stevenage (England).
J. D. Swanwick, and D. G. Shurben.
Water Pollution Control, Vol 68, No 2, p 190-202, March-April 1969. 7 fig, 5 tab, 9 ref.

Descriptors: *Anaerobic digestion, *Detergents, Laboratory tests, *Sludge treatment, Treatment facilities, Toxicity, Costs, *Waste water treatment.
Identifiers: *Chemical treatment, *Amines.

A report on the use of aliphatic amines and related compounds for the treatment of anaerobic sludge inhibited by increasing amounts of anionic detergents. In initial laboratory experiments Amine HBG and Diamine HPL were used as their acetate salts and added at half the molar equivalent of anionic detergent present in the digesters. A marked response (gas production) to Amine HBG, and a smaller temporary response to Diamine HPL were noted. Fish toxicity tests showed the 48-h median tolerance limit for rainbow trout to be 35-45 mg/l Amine HBG but only 0.4-0.5 mg/l Diamine HPL. Toxicity tests also indicated that in the absence of anionic detergent, Amine HBG was itself toxic to methane bacteria. However, normal operation of a full-scale digester which had failed to produce gas after refilling was accomplished by adding Amine HBG acetate at half the molar equivalent of detergent present. Commercial alternatives to Amine HBG, Armac HT and Amine HBG acetate, and liquid dispersions of Armac HT were also tested, with the liquid dispersions being the most effective. Tests on some 30 other amine materials showed that only one group, ethoxylated amines (Ethomeens) to be more effective than Armac HT. However, the cost of liquid dispersions and the Ethomeens are estimated to be double that of Armac HT or Amine HBG acetate. (Galwardi-Texas)
W70-06622

HYDRAULIC CONTROL UTILIZING SUBMERGED EFFLUENT COLLECTORS,
Brown and Caldwell, Alhambra, Calif.
Theodore V. Lutge.
Journal of the Water Pollution Control Federation, Vol 41, No 8, p 1451-1455, Aug. 1969. 6 fig, 1 ref.

Descriptors: *Design, *Hydraulics, *Waste water treatment, Effluents, Sedimentation, Skimming, Weirs, Water pollution control.
Identifiers: *Effluent collectors, *Submerged collectors, Flow-level control.

Uniform distribution of flow to treatment units, constant water level control, uniform withdrawal of effluent, and where practical the elimination of turbulence may be attained by use of submerged effluent collectors. Where conventional Weirs are used the flow is introduced into sedimentation tanks at high energy levels. Continual weir adjustment, variation in water surface elevations of 4 to 6 inches, settling of tanks, and odors present problems with conventional systems. These shortcomings are overcome by use of the submerged collectors which consist of pipes fitted with orifices. Water levels can be maintained within plus or minus 0.5 inch and without significant orifice head loss, flow through the submerged unit is uniform and is at a lower energy level. A modulating control valve is needed in the outlet channel or pipe to control the water level for efficient skimming. (Berryhill-Texas)
W70-06623

CHARACTERISTICS OF SLUDGE DRYING,
Southern Methodist Univ., Dallas, Tex. Dept. of Civil Engineering.
J. C. Jennett, and I. W. Santry.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, SA5, p 849-863, October 1969. 7 fig, 3 tab, 13 ref.

Descriptors: *Sludge treatment, *Dewatering, Filtration, Sewage treatment, *Waste water treatment.
Identifiers: *Sand beds, Polymers, Activated sludge process, Parameters.

Some parameters involved in the drying process of a digested municipal sludge were listed and evaluated. Model drying beds were built in an existing sludge drying bed of the City of Garland, Texas to take advantage of an operating underdrain system. The bottoms of half of the units were sealed with a plastic liner to simulate an undrained system. Some units were roofed to eliminate rainfall as a variable and some units were constructed with windbreaks to eliminate wind action as a variable. At the end of 28 days on the open beds, the sludge moisture content had decreased an average of 58% on the underdrained beds as opposed to 10% on the identical but non-underdrained beds. The roofed beds had a slower drying rate than the open beds which is in direct conflict with results published elsewhere that indicated that covered beds increase the drying rate by as much as 50%. The results obtained from those beds equipped with windbreaks were inconclusive because the windbreaks, as constructed, were ineffectual in reducing the flow of wind across the sludge surface. The results of an evaluation of open beds with polymer additives indicated that the use of polymers in sludge improved the moisture removal capability of the system considerably. Little increase in moisture removal was noticed in the sludge dosed with 200 ppm of the various polymers over that sludge containing only 50 ppm of the various polymers. (Galwardi-Texas)
W70-06624

THE ACIDIFICATION OF A RAW SEWAGE SLUDGE,
Water Pollution Control Works, Halifax (Nova Scotia).
J. Hatfield.
Water Pollution Control, Vol 68, No 6, p 673-678, Nov-Dec 1969. 5 fig, 6 tab, 6 ref.

Descriptors: *Sludge treatment, *Sewage sludge, *Filtration, Textiles, Dissolved solids, *Waste water treatment.
Identifiers: *Dilution, *Acidification, *Elutriation, *Specific resistance, Infra-red spectra grease, Capillary suction, Precipitation.

The effect of acidification on the dewatering characteristics of a sewage sludge was analyzed. The sludge used throughout the experimental work was obtained from sewage containing mainly textile wastes. The addition of sulphuric acid precipitates finely-divided suspended matter and with very greasy sewages precipitation of soaps to their insoluble fatty acids occurs. Infra-red absorption spectra of the obtained grease and its two main fractions (fatty acids and unsaponifiables) were presented. The specific resistance determined by the capillary suction method was used for comp
ing filtrabilities. The addition of sulphuric a
greatly improved the filtrability of this particu
sludge with the maximum occurring at pH3. Ho
ever, this improvement is relatively small compa
with the improvement in filtrability obtained by
use of conventional conditioning agents.
minimum value for specific resistance of 0.3 x 1
the 9th power (sq s)/g was obtained. A 50 perc
increase in dissolved solids in the filtrate occur
upon acidification to pH3. It was also noted, tha
the pH increases, the specific resistance increa
sharply. No change occurred in the pH or filtrab
ty of acidified samples which were allowed to st
overnight and for several days. Increases in filt
bility were noted in samples of sludge on wh
dilution, acidification and elutriation had been p
formed. The elutriated sludge filtrability increa
the least on dilution, and no appreciable loss
suspended solids was noted upon elutriation. T
improved filtrability may be due to the removal
electrolytes. (Galwardi-Texas)
W70-06625

**OPERATOR TRAINING BY AN IN-PLANT A
PRENTICESHIP PROGRAM,**
Orange County Sanitation Districts, Fountain V
ley, Calif.
Fred A. Harper.
Journal of the Water Pollution Control Federati
Vol 41, No 12, p 2010-2017, Dec 1969.

Descriptors: *Training, *Operations, *Educati
*Waste water treatment, Schools (Education).
Identifiers: *Orange County (Calif), *In-Pl
Training, *Operator.

The Orange County Sanitation Districts (Calif
nia) have developed a two phase in-plant opera
training program. The waste water quality cont
system serves a population of 1.25 million and p
jections indicate 2.5 million by year 2000. With
jectives to train personnel for maximum benefits
the Districts, the individual, the community, and
dustry, the program was initiated in July, 19
Educational requirements and program outli
are given for Apprentice I and Apprentice II. T
Apprentice I program must be completed bef
entering the Apprentice II program. Participa
are trained in all levels of operation of units and
routine laboratory work. Records and report w
ing are stressed throughout the program. A s
benefit is gained from existing personnel prepar
and applying training methods and techniqu
(Berryhill-Texas)
W70-06626

**THE ACTIVATED-SLUDGE PROCESS AS
HIGH-RATE SEWAGE-TREATMENT SYSTE**
Simmon-Carves Ltd., Stockport (England).
J. W. Abson, and E. I. Clark.
Water Pollution Control, Vol 68, No 5, p 574-5
1969. 4 fig, 3 tab, 8 ref.

Descriptors: *Waste water treatment, *Activa
sludge, *Biochemical oxygen demand, *Dissol
oxygen, Pilot plants, Nitrification, Ammonia,
fluents, Design, Aeration.
Identifiers: *Suspended solids, *Sludge volu
index (SVI), Phosphate removal, Respirometer.

It has been shown that with simple substrates a
mixed cultures the oxidation rate was not dep
dent on the substrate concentration. Four pilot s
dies on domestic sewage demonstrated that
30:20 standard could be met using the describ
high-rate activated sludge process. A range of BO
loadings between 0.22 and 0.69 lb/lb MLSS-
produced no difficulties in sludge settling. This
attributed to high concentrations of DO in
mixed liquor entering the settling tank and
satisfaction of the BOD. Substantial amounts
ammonia were removed with significant reducti
in the settling tank. This was attributed to high
tivated sludge concentration and high DO le
(8mg/l) of the effluent entering the settling ta
Analysis showed that 70-75 percent of the inco

phosphate was removed at Works III plant. In
ems with high MLSS Sludge Volume Index
es in excess of 100 did not present problems if
dequate DO level was maintained. In operation
ompact systems hydraulic loading was main-
ed within defined limits. The system described
rporates the efficiency of the lower-rate
ess and the cost savings of the high-rate
em. (Berryhill-Texas)
)-06627

**ANTITATIVE METHODS FOR THE CON-
TRATION OF VIRUSES IN WASTE
TER,**
ona Univ., Tucson. Dept. of Microbiology.
ion L. Moore, Peter P. Ludovici, and Wayburn
ester.
rnal of the Water Pollution Control Federation,
42, Research Supplement, p R21-R28, Februa-
970. 6 fig, 8 ref.

criptors: *Adsorption, *Membrane, *Viruses,
ste water treatment.
ntifiers: *Poliovirus type 1, *Viral monitoring,
erovirus, Filtration, Aluminum hydroxide,
vex Resin Column, Protamin Sulfate.

effectiveness of viral concentration procedures
a viral monitoring procedure was investigated.
mples seeded with poliovirus showed a recovery
ranging from 0.6 to 5.0 percent when using a
mbrane concentration procedure. Eighty-nine
cent of the loss occurred during the preconcen-
ion steps when the water was clarified and freed
acteria by passage through AP 20 prefilters and
0.22 micro membranes. Serum pretreatment of
AP 20 pads for removal of debris and use of un-
ated Gelman GA-8, 0.20 micro membranes for
moval of organisms was found to be the most ef-
tive preconcentration procedure. Two mem-
ne adsorption procedures, using protamine
fate and anion exchange resin, for concentrating
us were compared with an aluminum hydroxide
us adsorption technique. The most effective
cedure was the Al (OH) sub 3 method yielding
to 100 percent virus recovery as compared to
y 23 to 38 percent for membrane adsorption
hniques. (Bishop-Texas)
70-06628

**E USE OF TETRAZOLIUM SALTS AS A
EASURE OF SLUDGE ACTIVITY,**
ronto Univ. (Ontario). Dept. of Civil Engineer-
.
ilip H. Jones, and Durga Prasad.
urnal of the Water Pollution Control Federation,
l 41, No 11, Part 2, p R441-R449, November
69. 98 fig, 1 tab, 23 ref.

scriptors: *Reduction, Sludge, Aeration, *Waste
ter treatment, Irradiation.
ntifiers: *Metabolic activity, *Dehydrogenase,
hloride, Oxygen uptake, Triphenyltetrazolium,
duction, pH, Triphenylformazon.

e rate of oxygen uptake is one method of
ablishing the activity of organisms. For each
olecule of oxygen used two hydrogen atoms are
eased. Thus the rate of release of hydrogen
oms would be an equally accurate measure of
etabolic activity of a completely aerobic system.
ne method which measures this dehydrogenase
tivity makes use of triphenlytetrazolium chloride
TC) a colorless substance which upon reduction
es to triphenylformazon (TPF) a red-colored
bstance. The effects of aeration, pH,
otochemical reduction and gamma irradiation
dehydrogenase activity were studied. Com-
risons were made between oxygen uptake and
PF production. It was found that oxygen is a com-
titive inhibitor in the TTC-TPF reaction, that the
oduction of TPF reaches a peak and fades off
th time, that the effect of pH is extremely
oticeable, that a high degree of photochemical ac-
vity is observed at high pH values, that gamma-ir-
diated waste water maintains some residual
hydrogenase activity and that dehydrogenase ac-
tivity may be correlated with oxygen uptake. The results show that TTC at best can be considered as a gross measurement of activity. (DiFilippo-Texas)
W70-06629

BACTERIOLOGY OF AN ACTIVATED SLUDGE WASTE WATER TREATMENT PLANT - A GUIDE TO METHODOLOGY,
Western Washington State Coll., Bellingham.
Bruce Lighthart, and R. T. Oglesby.
Journal of Water Pollution Control Federation, Vol 41, No 8, Part II, p R267-R281, Aug. 1969. 6 fig, 6 tab, 33 ref.

Descriptors: *Methodology, *Activated sludge, *Waste water treatment, Isolation, Biomass, Costs, Ecosystem, Biochemical Oxygen Demand.
Identifiers: *Bacteriology, Isolet test battery, Cluster analysis.

A methodology whereby data to construct a factual and detailed description of the bacterial ecosystem is presented. Using a miniaturized and mass inoculation procedure, a battery of tests to measure physiological, biochemical and morphological characterizing features of a large number of waste water isolates have been developed. The tests indicate that there are several diffuse groups of organisms in the raw waste water and at least three clusters in settled biomass and aerator effluent. The latter three clusters have properties similar to Pseudomonds and Achromobacter and Flavobacteria-cytophaga genera, respectively. The techniques presented are relatively simple and are low in both monetary and temporal costs and provide information needed for ecosystem analysis for improved new designs and biological treatment facilities. (Shankar-Texas)
W70-06630

RECENT PROGRESS IN THE BLACKBURN MEADOWS RECONSTRUCTION AND EXTENSION SCHEME AT SHEFFIELD,
Sheffield Sewage Disposal Dept. (England).
A. Holroyd.
Water Pollution Control, Vol 68, No 3, p 357-367, May-June, 1969. 5 fig, 3 ref.

Descriptors: *Flow control, *Disposal, *Costs, *Waste water treatment.
Identifiers: *Settling tank, *Sludge incineration, Sludge scraper, Sludge withdrawal, Photoelectric probe, Furnace, Screening.

Certain phases of the Blackburn Meadows reconstruction and extension scheme are discussed. Emphasis is placed on phases relating to settling tanks and sludge incineration plant both of which are nearing completion. Eight new rectangular settlement tanks have been constructed each 234 feet by 75 feet, 11 feet depth at inlet and 10 feet at outlet. Each tank is provided with a 'buoyant flight' sludge scraper. Flow control is accomplished by a semi-automatic system. In addition a system of sludge withdrawal has been designed for equal sludge outputs from each of the tanks. Control of sludge blanket surface to any predetermined level is maintained using a photo-electric probe. The final disposal of the sludge by incineration is discussed. The Nicholas-Herreshoff multiple hearth furnace is recommended for incineration. Details of the feeder system, control room, furnaces, shaft cooling and scrubber system are dealt with and estimates of costs of the installation are presented. (Shankar-Texas)
W70-06631

AERATION IN WASTE WATER TREATMENT - MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washington, D.C. Technical Practice Committee.

Miles A. Lamb (Chairman) and W. E. Dobbins (Vice Chairman) of the Subcommittee. Journal of the Water Pollution Control Federation, Vol 41, No 11, p 1863-1878, Nov 1969. 9 fig, 3 tab.

Descriptors: *Waste water treatment, *Aeration, *Diffusion, *Oxygen requirements, *Maintenance, *Diffusivity, *Oxygen, *Operation and maintenance, Oxygenation, Oxidation lagoons.
Identifiers: Aerators, Air diffusers, Diffusers, Mechanical aerators, Oxygen uptake rate.

'Aeration in Waste Water Treatment' is the revised edition of the original Manual of Practice No. 5 entitled 'Air Diffusion in the Sewage Works', published in 1952. The manual provides designers, operators, and maintenance personnel of waste water treatment facilities with the basic theory and operational aspects of aeration. This first installment of a three part serialization covers the first two chapters of the manual. Subjects covered include a brief history of aeration, brief summaries of aeration processes in waste water treatment, and air introduction devices. Subjects covered in the second chapter generally deal with determination of oxygen requirements. Specifically, it covers air requirements for waste water treatment, oxygen uptake rates, rates of solution of oxygen, full-scale testing, and mixing requirements. (Makela-Texas)
W70-06632

AERATION IN WASTE WATER TREATMENT - MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washington, D.C. Technical Practice Committee.

Miles A. Lamb (Chairman) and W. E. Dobbins (Vice Chairman) of the Subcommittee. Journal of the Water Pollution Control Federation, Vol 41, No 12, p 2026-2061, Dec 1969. 28 fig, 1 tab.

Descriptors: *Waste water treatment, *Aeration, *Diffusion, *Oxygen requirements, *Maintenance, *Diffusivity, *Oxygen, *Operation and maintenance, Oxygenation, Oxidation, Lagoons.
Identifiers: Aerators, Air diffusers, Mechanical aerators, Oxygen uptake rate, Manual of operation oxygenation capacity.

'Aeration in Waste Water Treatment' is the revised addition of the original Manual of Practice No. 5 entitled 'Air Diffusion in the Sewage Works', pbulished in 1952. The manual provides designers, operators, and maintenance personnel of waste water treatment facilities with the basic theory and operational aspects of aeration. This is the second installment of a three part serialization and covers the third and fourth chapters of the manual. Chapter 3 covers types and applications of diffusers. Specific subjects include diffuser location, mounting and number, oxygenation capacity, calculation of air requirements, air distribution, economics, flexibility, porous diffusers, non-porous diffusers, and European practice. Chapter 4 covers the types and applications of mechanical aerators. Specific subjects include plate types, brush types, European practice, and aerated lagoons. (Makela-Texas)
W70-06633

COOLING TOWERS AND WEATHER, REPORT TO FEDERAL WATER POLLUTION CONTROL ADMINISTRATION,
Oregon State Univ., Corvallis. Dept. of Physics.
F. W. Decker.
Typescript 26 p, February 1969. 2 fig, 17 ref.

Descriptors: *Cooling towers, *Weather, *Fog, *Precipitation, Humidity, Mixing, Temperature, Evaporation.
Identifiers: *Site selection, Esthetic effects, Drizzle intensities, Plumes, Eliminators.

Possible nuisances created by heated air and water vapor raised questions of fog, precipitation and esthetic effects on neighboring property usage. These effects will be minimum if the drizzle falls into a relatively deep layer of air and thereby evaporates with great dilution by air. Thus the natural-draft tower has an advantage over the forced-draft tower because of the greater height of the efflux from the former. Objective determination of fog-forming capabilities as a result of

suspected drizzle from cooling tower plumes will require field information about the actual drizzle intensities and effectiveness of such drizzle in producing surface fog. Empirical probabilities of high humidity and light air movement in combination with surface air cooling represents the chief source of information obtained from the estimate of the frequency of occurrence of fog nuisance created by the cooling tower. 'Eliminators' which intercept the upward carried driplet in the region above the packing and the windbreak or screening to prevent strong winds blowing directly across the bottom of the cooling tower, are the modern solutions of the problem. Other solutions are site selection to assure an adequate area around the tower in which any precipitation may fall without nuisance and site selection to eliminate possible nuisance of the cooling tower for nearby activities. European experience and calculations for American conditions showed low probability of fog while uncertainties concerning precipitation may need resolution to determine certain marginal probabilities of drizzle-caused fog. (Upadhyaya-Vanderbilt)
W70-06639

THERMAL POLLUTION AND THE WATER COOLING TOWER,
Marley Co., Kansas City, Mo.
J. B. Dickey, Jr., and R. E. Cates.
Marley Co., Kansas City, Mo, 1970. 14 p, 8 fig.

Descriptors: *Thermal pollution, *Cooling towers, Cooling, Heat balance, Ventilation, Condensation, Water cooling, Thermal powerplants, Electric power industry, Steam, Thermal power, Evaporation, Temperature, Air temperature, Saturation.

One solution to thermal pollution by the electric utility industry lies in the use of water cooling towers. Various operating needs include small unit municipals through syndicates operating multiple units aggregating over 5000 mega watts. Operating conditions include constant on-line recirculating, stand-by or 'trim' duty, and once-through systems to limit terminal differences. Types of towers are discussed as larger induced draft, forced and assisted draft, natural draft, and the DriTower. Geographical aspects of design and operating problems are outlined. Accompanying the discussion is a presentation of evaluation factors including methods of selection and optimization of both Mechanical and Natural Draft Cooling Towers. (Novotny-Vanderbilt)
W70-06640

BIOLOGICAL RECOVERY OF WASTE WATER,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
K. L. Schulze.
Journal Water Pollution Control Federation, Vol 38, No 12, p 1944-1958, 1966. 2 fig, 4 tab, 15 ref.

Descriptors: *Waste water (Pollution), *Biological treatment, Tertiary treatment, Michigan, Biochemical oxygen demand, Turbidity, Suspended load, Coliforms, Aquatic plants, Fish, Dissolved solids, Chemical oxygen demand, Nitrates, Phosphates, Conductivity, Hydrogen ion concentration, Temperature, Dissolved oxygen, Biological communities, Sphaerotilus, Beggiatoa, Diatoms, Cyanophyta, Chlorophyta, Rotifers, Annelids, Crustaceans, Copepods, Snails, Turtles, Chlorella, Euglena, Scenedesmus, Chlamydomonas.
Identifiers: East Lansing (Mich), Lebistes, Vallisneria, Potamogeton, Elodea, Ceratophyllum, Lemna, Myriophyllum, Zoogloea, Nitzschia, Navicula, Oscillatoria, Rhizoclonium, Paramaecium, Stentor, Epistylis, Tubifex, Aeolosoma, Cladocera, Ostracoda, Physa, Helisoma, Graptemys.

In attempting to develop biological treatment methods for complete recovery of waste water, a model tertiary biological waste treatment process was operated using final effluent from the East Lansing, Michigan, sewage treatment plant (activated sludge) as raw material. The model was operated under continuous-flow conditions and at retention times varying from 10 to 36 hours. At about 24-hour retention time, removals on the order of 90% for biochemical oxygen demand, 92% for turbidity, 94.5% for suspended solids, and 96% for coliform bacteria were obtained. These removals correspond to overall reduction values of 98 to 99% for the combined secondary and tertiary treatment processes. Preliminary data indicated that reduction in phosphorus through the tertiary unit was on the order of 20 to 30%. The effluent from the tertiary unit was discharged through a 10-gallon aquarium stocked with water plants and a pair of guppies. The plants produced luxuriant growth and the fish went through their reproductive cycle with no extraneous food supply. Similar results were obtained with a set of 200-gallon tanks where young minnows, dace, lake chub, green sunfish, black crappies, and large-mouth bass were used as test fish. (Jones-Wisconsin)
W70-06671

THE WASTE TREATMENT MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06687

SYNTHESIS OF THE DISPERSION AND WASTE TREATMENT MODELS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06688

REDUCTION OF RIVER HEAT POLLUTION BY TURBULENCE STIMULATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
Victor E. Scottron.
Completion Report, March, 1970. 3 p. OWRR Project A-011-CONN.

Descriptors: *Thermal pollution, Turbulence, Diffusion.

The results of two experiments are report: (a) A wind tunnel study was made of a two-dimensional natural river bed model containing sand waves. Data were taken regarding mean velocity distribution angle of flow, static pressure distribution and longitudinal turbulence intensity along a typical wave. While valuable conclusions were obtained concerning the mechanism of bed-load transport, natural bottom roughness did not appear to assist in preventing thermal stratification. (b) A wind tunnel study was made of a two-dimensional heat-stratified flow. A mathematical model was developed and compared with measured temperature profiles for flow over both smooth and rough boundaries. Increased turbulence levels greatly accelerated the mixing rates.
W70-06704

5E. Ultimate Disposal of Wastes

LEGAL ASPECTS OF LAKE DIVERSION (DIVERSION FROM LAKE MICHIGAN, AND DISPOSAL OF SEWAGE INTO THE MISSISSIPPI WATERSHED, BY CHICAGO),
For primary bibliographic entry see Field 06E.
W70-06477

SELECTION OF REFUSE DISPOSAL SITES IN NORTHEASTERN ILLINOIS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 05B.
W70-06572

BIOLOGICAL ASPECTS OF ORGANIC WAST TREATMENT,
Bath Univ. of Technology (England).
For primary bibliographic entry see Field 05D.
W70-06588

A REVIEW OF POULTRY WASTE DISPOSA POSSIBILITIES,
Ministry of Agriculture, Fisheries and Food, Lo don (England).
C. T. Riley.
Water Pollution Control, Vol 67, No 6, p 627-63 1968. 5 tab, 4 ref.

Descriptors: *Waste disposal, *Waste treatme *Biochemical oxygen demand, *Costs, Was identification, Drying, Land use, Aeration, Loa ing, Odor.
Identifiers: *Poultry waste disposal, *Bod/food i take relation, *Waste storage, *Chemical a physical properties (Waste), Heat dryin Nitrogen, Phosphorus, Potassium, Pasveer ditc Bubble-gun installation, Processing statio (Poultry), Deep litter and broiler houses, Inedib by-products, Shock load.

Waste disposal problems in the poultry industr contemporary poultry practice and relat developments in agriculture are discussed, a trends considered. The main types of waste a analyzed; wastes from laying hens has higher NP values than any other agricultural waste. A N tional Agricultural Advisory service (NAAS) su vey emphasized the lack of knowledge, high cost waste disposal to egg producers and social effec of the current tendency to increase livestock nu bers and (due to transportation costs) to gro production units near centers of consumptio Analysis is made of waste quantities and the chem cal and physical properties of the waste. A reliab correlation appears to exist in BOD/food intal relationship. Settling difficulties in treatment a noted. The relationships between disposal practic and land uses are examined. The major problen arising from traditional methods of disposal a analyzed, especially the storage and heat dryi phases. Traditional methods of sewage treatme no longer appear suitable for poultry wastes. Th 'Pasveer ditch' or 'bubble-gun' type of installatio may be more suitable; however, the high conce tration of waste remains a problem. The treatme and disposal of wastes from deep litter and broil houses is troublesome mainly if local accumul tions become too large. This type of waste has th highest nitrogen content of all agricultural waste (D'Arezzo-Texas)
W70-06590

FARM WASTE DISPOSAL IN RELATION T CATTLE,
National Agricultural Advisory Service, Londo (England).
J. Gibbons.
Water Pollution Control, Vol 67, No 6, 1968. 622-626, 2 tab, 4 ref.

Descriptors: *Disposal (Wastes), *Waste trea ment, *Cattle, *Livestock, *Farm wastes, Cost Silage, Effluent, Economic impact, Digestio Drains, Groundwater, Streams, Buildings, Co struction.
Identifiers: *Farm waste disposal, *Farm was production, *Cow cubicles, *Dry-land farr *Silage effluent, *Wet farms, Populatio equivalents of farm waste, Farming patterns, Sol systems, Organic irrigation, Slurry handling, Cub cle-housing/law labour system, Storage.

Changes in the pattern of farming and consequer effects on the nature of manure disposal proble on farms are discussed. Modern systems of dai farming, including the special impacts widespread production of silage, and the growth the cubicle system of housing are examined. Th consequent effluent disposal problems are eval ated. Design of disposal systems must take into a count: animal waste quantity estimates and th

lation equivalents of these farm wastes. Also, l factor in design requirements is evaluation of hanging patterns of farming. Waste treatment lisposal are discussed from the viewpoints of systems, handling organic irrigation methods, lurry handling methods. The factors affecting ge requirements and capacities are analyzed. mportant consideration in most systems is to the volume of contaminated liquid to a num and this is a vital factor in building n. Silage effluent treatment is given special at- on because of the serious pollution problem h it can create. Special efforts are required to silage effluent from entering drains, streams, roundwaters. Proper system design must con- land use, the type of existing facilities, the of enterprise, and type of livestock. Economic technical considerations jointly should under- e final design decisions. (D'Arezzo-Texas)
-06591

DGE TREATMENT AND DISPOSAL AT BROCKHURST WORKS OF THE UPPER IE MAIN DRAINAGE AUTHORITY,
er Tame Main Drainage Authority, Bir- gham (England).
primary bibliographic entry see Field 05D.
0-06594

TUSE DISPOSAL IN DUTCHESS COUNTY, V YORK.
York State Office of Planning Coordination, any.

pared in cooperation with Dutchess COUNTY t. of Planning, Poughkeepsie, N. Y. Available n the Clearinghouse as PB-188 786, $3.00 in er copy, $0.65 in microfiche. Report Aug, 9. 75 p, 8 tab, 3 append. HUD Project UPAP P-87 (New York)

criptors: *Industrial wastes, *Waste disposal, itary engineering, Municipal wastes, *Sanitary ineering, Sewage, Rural areas, Incineration, planning, Domestic wastes.
ntifiers: Regional planning and development, utches County (N Y), *Refuse disposal, *Sani- landfills, Solid waste disposal, *Refuse com- ing.

s study reviews existing local refuse disposal blems, available refuse disposal methods and ninistrative structures and overall implications refuse disposal as it relates to Dutchess County. view of existing refuse disposal service shows entially serious problems both in the urban core a and rural communities in complying with the visions of Part 19 of the State Sanitary Code af- ting refuse disposal. Evaluation of the problem a broad basis indicates economies can be ieved through the creation and operation of a unty-wide refuse disposal district and a system of nsfer stations. The study further recommends t the County apply for a N.Y.S. Solid wastes nning grant to further develop and implement s proposal.
70-06711

F. Water Treatment and Quality Alteration

STALLATIONS FOR OZONIZING WATER XCERPTS),
reign Technology Div. Wright-Patterson AFB, io.
F. Kozhinov.
ans. of mono. Ustanovki dlya Ozonirovaniya dy, Izd-vo Literatury po Stroitel'stvu, Moscow, 68, p. 9-21, 167-169, by D. Koolbeck. Available m the Clearinghouse as AD-700 476, $3.00 in per copy, $0.65 in microfiche. Rept. No. FTD- T-23-315-69, Oct. 15, 1969. 21 p, 9 fig, 47 ref.

escriptors: *Ozone, *Oxidation, *Chemical reac- ns, Molecular structure, Solubility, Oil, Coals, Water treatment.
Identifiers: USSR.

A brief statement of the history of the discovery of ozone and the determination of its physical constants is given. The molecular structures of the gas are outlined, and some details regarding the decomposition of ozone in air, distilled water, and various natural waters in Switzerland are presented. The solubility of ozone in water is examined and the coefficient of ozone distribution in a water/air system is determined. Reactions of ozone with inorganic materials are touched upon briefly, and a somewhat longer discussion of ozone reactions with organic substances, mainly wastes of coke and petroleum chemistry processes, is given.
W70-06453

5G. Water Quality Control

PRELIMINARY OPERATIONS PLANNING MANUAL FOR THE RESTORATION OF OIL-CONTAMINATED BEACHES.
URS Research Co., San Mateo, Calif.

Available from the Clearinghouse as PB-191 711, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report 15080 EOS 3/70, February 1970. 53 p, 15 fig, 21 tab. FWPCA Project 15080 EOS--- 3/70, Contract 14-12-811.

Descriptors: *Oily water, *Beaches, *Water pollution control, *Soil contamination, *Pollution abatement, Cleaning, Oil wastes.
Identifiers: *Beach restoration (Oily sand).

An Operations Planning Manual was prepared for use by FWPCA personnel involved in oil-spill cleanup operations. The surface conditions and topography of a beach contaminated with oil and the manner in which the oil has been deposited onto the beach will dictate the choice of equipment to be utilized and the operating procedures to be followed. The procedures tested utilize motorized graders, motorized elevating scrapers, front end loaders, and conveyor-screening systems. A motorized grader and motorized elevating scraper working in combination provide the most rapid means of beach restoration; and in addition, their use results in the removal of the smallest amount of uncontaminated beach material. (Knapp-USGS)
W70-06319

REVIEW OF THE SANTA BARBARA CHANNEL OIL POLLUTION INCIDENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05B.
W70-06320

SUMMARY OF WATER QUALITY STANDARDS FOR THE INLAND AND COASTAL WATERS OF TEXAS.
Federal Water Pollution Control Administration, Austin, Tex., and Texas Water Quality Board, Austin.

Federal Water Pollution Control Administration -- Texas Water Quality Board, Cooperative Report, September 1969. 43 p, 2 fig, 4 tab.

Descriptors: *Water quality act, *Water quality, *Standards, *Texas, Legislation, Water pollution, Water pollution control, Sewage treatment, Interstate, Water utilization.
Identifiers: *Texas water quality standards.

Texas adopted standards for its interstate and intrastate waters on June 26, 1967, which were then submitted to the Department of the Interior. Subsequently on October 5, 1967, revisions were made by Texas in their original standards, and the Secretary of the Interior approved the standards, as revised on January 27, 1968. At the request of the Secretary of the Interior, Texas adopted a policy to protect its high quality interstate waters, which was approved on May 2, 1969. The standards consist of three major components: designation of the uses which the waters are to serve, specification of narrative and numerical criteria to protect and enhance water quality, and specification of a plan of implementation and enforcement, which includes treatment and control requirements for municipal, industrial and other waste discharged to or affecting Texas waters. (Knapp-USGS)
W70-06357

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,
American Society of Civil Engineers, New York.
L. S. Tucker.
Available from the Clearinghouse as PB-191 714, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 6, Combined Sewer Separation Project, November 15, 1967. 35 p, 14 fig, 1 tab, 12 ref. FWPCA Project 11020 EKO-- 11/67, Contract 14-12-29.

Descriptors: *Sewers, *Storm drains, *Pressure conduits, Cities, Hydraulics, Pipes, Closed conduit flow, Waste disposal, Drainage systems, Engineering structures, Hydraulic transportation.
Identifiers: Combined sewage, High pressure sewers.

A general concept is proposed for separation of combined sewerage systems which involves discharging comminuted sewage from individual buildings or building complexes through relatively small pressure tubing. The tubing would connect to new transmission conduits located outside the buildings. The new separate sanitary sewage street pressure condiuits would then discharge into existing interceptors that would convey the sanitary sewage to treatment works. Storm water alone would be carried in what were formerly combined sewers. (Knapp-USGS)
W70-06406

FEDERAL AID TO THE STATES: AN ANALYTICAL EXAMINATION OF THE ALTERNATIVES,
Washington Univ., St. Louis, Mo.
Murray L. Weidenbaum.
The American Journal of Economics and Sociology Vol 28, No 4, p 367-383, October 1969. 17 p.

Descriptors: *Taxes, *Resource allocation, *Federal government, *State government, *Local government, *Economic evaluation, Government supports, Income, Human resources, Decision making, Investment, Costs, Revenue, Gross National Product, Tax rates.
Identifiers: *Tax sharing, *Tax credits, *Program grants, *Block grants, Economic stability, Tax base, Income redistribution.

Due to the intrastate nature of many water pollution problems Federal assistance in their solution has received considerable attention and this study of the economic problems involved is informative with respect to understanding the effects of federal aid to the States. The purpose of the article is to contribute to finding an optimal program for Federal assistance by arraying and objectively comparing the various alternative approaches. It examines the case for increased federal financial assistance to state governments and their subdivisions and analyzes the major alternative ways of distributing the aid. The alternatives examined are shared revenues, tax credits, direct federal operations, program grants, straight block grants, and block grants with an equalization feature. The criteria for evaluation are income distribution, resource allocation and stabilization. The study indicates that block grants with an equalization feature yield the greatest amount of income redistribution but that tax credits and tax sharing might tend to result in larger expenditures for selected areas, based on the recent allocation patterns of state budgets. (Murphy-Rutgers)
W70-06410

PERNELL V CITY OF HENDERSON (ACTION AGAINST MUNICIPALITY FOR THE UNREASONABLE DIVERSION OF WATER TO THE HARM OF RIPARIAN OWNERS).
For primary bibliographic entry see Field 04A.
W70-06474

ATMOSPHERIC EMISSIONS FROM WET-PHOSPHORIC ACID MANUFACTURE,
National Air Pollution Control Administration, Raleigh, N.C.; and American Cyanamid Co., Wayne, N.J.
For primary bibliographic entry see Field 05B.
W70-06521

MINE WATER RESEARCH: PLANT DESIGN AND COST ESTIMATES FOR LIMESTONE TREATMENT,
Bureau of Mines, Pittsburgh, Pa. Coal Mining Research Center.
For primary bibliographic entry see Field 05D.
W70-06532

POSSIBILITIES OF BIOLOGICAL CONTROL OF AQUATIC WEEDS IN INDIA.
Commonwealth Inst. of Biological Control, Bangalore (India).
For primary bibliographic entry see Field 04A.
W70-06549

COMMUNITY ACTION GUIDEBOOK FOR SOIL EROSION AND SEDIMENT CONTROL,
National Association of Counties Research Foundation, Washington, D.C.
Mel D. Powell, William C. Winter, and William P. Bodwitch.
Available from the Clearinghouse as PB-191 765, $3.00 in paper copy, $0.65 in microfiche. National Association of Counties Research Foundation Publication, p G1-G64, 1970. 64 p. FWPCA Grant No 15030 DTL--3/70.

Descriptors: *Soil erosion, *Sediment control, *Road construction, *Urbanization, Legislation, Water law, Soil conservation, Social aspects, Legal aspects, Governments.
Identifiers: Urban Sediment control.

Erosion and sediment, once thought of as rural problems, are causing extensive damage to the soil and water resources of developing communities. Sediment caused by careless development and construction has become one of the Nation's most serious sources of water pollution. This guidebook is intended to help local officials to organize, plan, finance, staff, and implement comprehensive sedimentation control programs. In addition it should help local officials and administrators understand what is basically a technical problem; it will also help soil and water experts and technicians understand the administrative aspects of sedimentation control. This mutual understanding is necessary if effective control is to be achieved. The concepts and principles presented are based on a year of research, including visits to federal and state agencies and 14 visits to local sedimentation control programs across the United States. A model approach, with appropriate modifications, may be used by many local governments to control their sedimentation problems (Knapp-USGS)
W70-06574

THE CONTROL AND TREATMENT OF TRADE EFFLUENTS,
Greater London Council, London (England).
For primary bibliographic entry see Field 05D.
W70-06589

TECHNOLOGIES IN COAGULATION,
Bissell, Bronkie and Associates, Williamsville, N.Y.
For primary bibliographic entry see Field 05D.
W70-06593

OXYGEN DEMAND AND SUPPLY IN AN ACTIVATED SLUDGE PLANT,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06598

OVERLOADED OXIDATION PONDS--TWO CASE STUDIES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06601

REGIONAL MANAGEMENT OF WATER QUALITY--A SYSTEMS APPROACH,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06602

A CRITICAL VIEW OF SPECTRO METHODS FOR WATER QUALITY CONTROL,
Department of Water and Power, Los Angeles, Calif.
George A. Uman.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R484-R488, Nov 1968. 2 fig, 8 ref.

Descriptors: *Spectroscopy, *Standards, *Statistics.
Identifiers: *Criticism, *Accuracy, *Procedures.

The statisticians influence on the spectrocopist from the standpoint of improving the accuracy of his analysis is criticized. The problems of sample selection, water quality criteria, analytical methods, and accuracy of results were discussed with this thought in mind, 'is there enough information known about standards, controlling parameters, and methods for meaningful results'. The shortcomings of the statistical approach are highlighted. (Hancuff-Texas)
W70-06611

WATER AND WASTE WATER, WATER POLLUTION CONTROL IN AUSTRALIA,
Metropolitan Water, Sewage and Drainage Board, Sydney (Australia); New South Wales Univ., Kensington (Australia).
K. B. Thistlethwayayte.
Water Pollution Control, Vol 68, No 2, p 256-274, March-April 1969. 3 fig, 6 tab, 13 ref.

Descriptors: *Water, *Waste water, *Water pollution, Sewage, Biochemical oxygen demand, *Waste water treatment.
Identifiers: *Water economy, *Artesian basins, *Bacteriological pollution, Beach pollution, Paper industry waste, Pollution control, Deoxygenation.

Water supply and sewage in Australia and its hydrology is compared broadly with that of Europe. It is observed that interest in water supply, largely surface water, is mainly confined to aspects of quantity, rather than quality. But sewage treatment has received a greater share of attention. In 1965 about 60 percent of the sewage flow was being treated before discharge to final disposal areas. Water pollution in Australia is not very serious when compared with data available from European sources. Problems caused by urban run-off and sewage from unsewered areas are comparatively widespread but are given poor attention. Water resources management is also gaining importance with the setting up of the Water Research Foundation of Australia in 1955 and of Australian Water Resources Council in 1963. The author is hopeful that with growing post graduate activity in public health engineering, the present general and specific water engineering problems could be solved to a greater extent. (Shankar-Texas)
W70-06615

SIMPLIFIED MATHEMATICAL PROCEDU FOR DESIGNING POST AERATION SYSTEM
Rex Chainbelt, Inc., Milwaukee, Wis. Proc Equipment Div.
Richard A. Kormanik.
Journal of the Water Pollution Control Federati Vol 41, No 11, Part I, p 1956-1958, Nov. 1969.

Descriptors: *Aeration, *Dissolved oxygen, fluent, Design, Waste water treatment.
Identifiers: *Oxygen transfer coeffieient, *Po aeration, Steady-state, Mass-balance, Surface ae tion, Horsepower.

The development of a design procedure presented for mathematically determining basin size and the mechanical surface aeration h sepower required to bring a pretreated waste h ing an initially low DO level to the higher le required by the receiving waters. The proced outlined takes into account the oxygen-utilizati rate of the waste effluent as well as other paran ters such as flow, temperature, and the waste fluent-oxygen transfer coeffieient corrections. T design equation presented will produce a post ae tion system design which will be only as reliable the design procedure. The developed design eq tion indicates that when the waste effluent flow considered to have an oxygen-utilization rate eq to zero, the post aeration basin detention time d not become a design parameter. With an oxyg utilization rate taken into consideration, the ae tion horsepower requirement becomes direc proportional to the detention time. A sample cal lation is also given. (Shankar-Texas)
W70-06616

FIELD EVALUATION OF THE PE FORMANCE OF EXTENDED AERATI PLANTS,
Cincinnati Univ., Ohio. Dept of Environmen Health.
For primary bibliographic entry see Field 05D.
W70-06620

HYDRAULIC CONTROL UTILIZING SU MERGED EFFLUENT COLLECTORS,
Brown and Caldwell, Alhambra, Calif.
For primary bibliographic entry see Field 05D.
W70-06623

AERATION IN WASTE WATER TREATMENT MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washingto D.C. Technical Practice Committee.
For primary bibliographic entry see Field 05D.
W70-06632

AERATION IN WASTE WATER TREATMENT MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washingto D.C. Technical Practice Committee.
For primary bibliographic entry see Field 05D.
W70-06633

CITY OF LOUISVILLE V TWAY (LOWE RIPARIAN OWNER CONTESTING DAM ACROSS STREAM AND POLLUTION UPPER RIPARIANS).
For primary bibliographic entry see Field 04A.
W70-06664

DETERGENT ENZYMES: BIODEGRADATIO AND ENVIRONMENTAL ACCEPTABILITY,
Monsanto Co., St Souis, Mo. Inorganic Chemic Div.
R. D. Swisher.
BioScience, Vol 19, No 12, p 1093-1094, 1969 tab, 5 ref.

Descriptors: *Biodegradation, *Detergents, *E zymes, Environmental gradient, Cultures.
Identifiers: Bacillus subtilis, Protease activity, E zyme SG-2331.

ssessment of the biodegradability of enzymes porated into laundry detergents was made. rvations were confined to a composite sentative of commercial ingredients, uced from Bacillus subtilis (SG-2331). Trials ucted in shake-cultures, river water, and ge with both alkaline and neutral proteases sted that the rapid biodegradability of the de- nt's enzyme would preclude unfavorable en- mental reactions. (Wilde-Wisconsin)
-06673

NOMIC EVALUATION OF WATER LITY: A MULTICOMPONENT MODEL OF IMAL QUALITY CONTROL IN UARINE WATERS,
ornia Univ., Berkeley. Sanitary Engineering earch Lab.
hir K. Mukherjee.
L Report No 69-2, January 1969. 103 p, 11 fig, ab, 44 ref, 3 append. FWPCA Grant WP-597-

criptors: *Optimization, *Water quality con- *Estuaries, *Economic feasibility, Linear pro- mming, Dispersion, Water allocation (Policy), te treatment, Operations research, California. tifiers: Multicomponent model.

objectives of the study were to utilize opera- research techniques to determine the nomic effects of changing water quality require- ts of an estuarine water basin. Dispersion dels were developed for estimating the optimal cation of water quality in an estuary to achieve ous related objectives. Optimal control theory used to solve the continuous versions of these dels and obtain an insight into the nature of op- al discharge policies. The study sought to ove the limitations of an earlier linear pro- mming model by developing an integrated mul- mponent model of dispersion and waste treat- nt. This model simultaneously provided an op- al plan of water treatment, along with a plan of imal waste discharge into the estuary. (See also 0-06685 thru W70-06688). (Thiuri-Cornell)
0-06684

NEAR OPTIMAL CONTROL THEORY AND E CONTINUOUS DISPERSION MODEL,
lifornia Univ., Berkeley. Sanitary Engineering search Lab.
rshir K. Mukherjee.
SERL Report No 69-2, Chap IV, p 23-47, nuary 1969. 25 p, 5 fig, 1 tab. FWPCA Grant P-597-05.

scriptors: *Optimization, *Dispersion, *Estua- s, *Water quality control, Discharge measure- ent, Cross-sections, Volume, Hydrologic proper- s, Flow measurement, Physical properties, Pollu- nts.

e general solutions of steady state dispersion odels, reformulated as linear optimal control oblems with state variable constraints, were esented. Four specific problem situations were scussed, ie., linear optimal control problem, inimum principle for linear optimal control oblem, transversality conditions, and linear op- nal control problem with state variable con- raints. Basic results of linear optimal control eory and the related minimum principle were veloped. Solutions were obtained for the con- nuous versions of the models by applying optimal ntrol theory. The behavior of the optimal scharge policy in relation to the functions presenting hydrological variables such as volume ow and cross-sectional area of the estuary was scussed. (See also W70-06684). (Thiuri-Cornell)
70-06685

ATHEMATICAL PROGRAMMING FORMU- ATION OF THE DISPERSION MODEL,
alifornia Univ., Berkeley. Sanitary Engineering esearch Lab.
hishir K. Mukherjee.
In: SERL Report No 69-2, Chap V, p 48-61, January 1969. 14 p, 1 fig, 3 tab. FWPCA Grant WP-597-05.

Descriptors: *Linear programming, *Estuaries, *Estimating, *Optimization, *Dispersion, Sampling, Diffusion, Approximation method, Discharge (Water), Velocity, Prices, Computer programs, Cross-sections.
Identifiers: Steady state models, Nonsteady state models, Discrete models.

Discrete linear programming models were developed to estimate estuaries dispersion coefficients, using the data available from sampling studies of the estuary. Linear programs were generated to take advantage of the fast computer routines available for the solution of linear programming problems. The nonsteady state models, which gave rise to distributed parameter optimal control problems in the continuous case, were also formulated as linear programs under discrete approximation. An alternative approach of representing the steady state models as linear programs was described. The estuary was divided into small longitudinal sections using the solution of the diffusion equation in each of them to generate coefficients for the linear programs. The solution obtained estimated the optimal values of cross-sectional area, dispersion coefficient, advective velocity, constituent concentration, constituent discharge rate per unit of time within each reach of the estuary and the dual shadow prices. (See also W70-06684). (Thiuri-Cornell)
W70-06686

THE WASTE TREATMENT MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Shishir K. Mukherjee.
In: SERL Report No 69-2, Chap VI, p 62-67, January 1969. 6 p, 1 tab. FWPCA Grant WP-597-05

Descriptors: *Linear programming, *Waste water treatment, *Municipal wastes, *Industrial wastes, *Optimization, *Pollution abatement, Biochemical oxygen demand, Estuarine environment, Water quality control, Basins, Standards.

A linear programming waste treatment model was used to determine optimal treatment levels for all waste producing agencies in the region. The objective of the model was to minimize the regional treatment costs subject to stream quality standards. The quality of the water in the stream was characterized by the amount of chemical components such as phenols, biochemical oxygen demand, phosphate and nitrogen, present. The quality standards specified the maximum amount of each component that could be discharged at each plant. The decision variables were the amount of untreated effluent from each sector to be treated by each treatment method. The inequalities of a minimum regional cost approach were discussed and the use of effluent charges indicated by the shadow costs in the linear programming solution to encourage near-optimal treatment was suggested. (See also W70-06684). (Thiuri-Cornell)
W70-06687

SYNTHESIS OF THE DISPERSION AND WASTE TREATMENT MODELS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Shishir K. Mukherjee.
In: SERL Report No 69-2, Chapter VII, p 68-77, January 1969. 10 p, 2 tab. FWPCA Grant WP-597-05.

Descriptors: *Waste treatment, *Dispersion, *Water quality control, *Optimization, Synthesis, Estuaries, Planning, Economics, Operating costs, Growth rates, Productivity, Flexibility, Equitable apportionment.
Identifiers: Multicomponent models.

A complete model of estuarine water quality management was obtained by a synthesis of the dispersion and waste treatment models. The multicomponent water quality model simultaneously provided optimal plans of treatment and discharge along the estuary. The economics of alternative methods of quality improvement and cost reduction schemes like transportation of waste from one section of the estuary to another or process changes were studied. Economic growth projections and other modifications like inclusion of social costs were also incorporated in this model. Dual prices could be used as a basis for a system of charges aimed at equitable distribution of operating costs among discharges, motivating them to reduce waste discharge by improving production and waste treatment processes. The main advantages of the model were its multicomponent nature, availability of standard computer codes for fast solution, direct output of optimum treatment plans, and flexibility regarding various objectives. (See also W70-06684). (Thiuri-Cornell)
W70-06688

A MODEL OF PUBLIC DECISIONS ILLUSTRATED BY A WATER POLLUTION POLICY PROBLEM,
Harvard Inst. of Economic Research, Cambridge, Mass.
Robert Dorfman, and Henry D. Jacoby.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Subcommittee on Economy in Government , Joint Economic Committee, 91st Congress, Wash, DC, May 1969, p 226-274. 4 fig, 9 tab, 11 ref.

Descriptors: *Water pollution control, *Mathematical models, *Decision making, Hydrologic aspects, Political aspects, Social values, Costs, Benefits, Economics.

A mathematical model of a water pollution problem was constructed to aid in the political decision making process. A hypothetical river basin was modelled to illustrate how a problem of governmental decision making could be expressed in a formal model and analyzed fruitfully. There were a variety of hydrologic technical, social, political, and economic issues invloved including conflicts of interest among the users of the basin's water resources. The model provided a useful way to manage the diverse kinds of data that were pertinent to the problem. The solution of the model defined both aggregate and individual user costs and benefits. It also provided a way to coordinate fragmented data and to analyze the effects of different assumptions that might reasonably be adopted. (Thiuri-Cornell)
W70-06690

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

APPLICATION OF RUN-LENGTHS TO HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-06332

THE COVARIANCE MATRIX OF THE LIMITED INFORMATION ESTIMATOR AND THE IDENTIFICATION TEST,
Cornell Univ., Ithaca, N.Y.; and Purdue Univ., Lafayette, Ind.
Ta-Chung Liu, and William J. Brein.
Econometrica, Vol 37, No 2, p 222-227, April 1969. 6 p, 10 ref.

Descriptors: *Statistics, *Economics, *Estimation, Mathematical studies, Model studies, Maximization.

Identifiers: *Limited information, *Variance, *Econometrics, Likelihood estimator, Covariance matrix.

Two well known aspects of the limited information maximum likelihood method of estimating simultaneous equation systems are discussed. This method has potential use in water resource estimation problems and its clarification should be of use to the water resource planner. The author gives a straightforward derivation of the asymptotic covariance matrix of the limited information maximum likelihood estimator which yields results different from, and simpler than, the established formulae. The article also demonstrates that the statistical test of the validity of the a priori restrictions does not appear to yield satisfactory results. (Murphy-Rutgers)
W70-06417

DECENTRALIZATION IN SEPARABLE PROGRAMMING,
Louvain Univ. (Belgium); and Iowa State Univ., Ames.
Paul V. Moseseko, and Guy De Ghellink.
Econometrica, Vol 37, No 1, p 73-78, January 1969. 9 ref.

Descriptors: Statistical methods, Computer programs, Constraints, Prices.
Identifiers: *Decentralization, *Separable programming, Solutions, Subproblems, Concavity, Maximands, Convexity, Feasible sets.

The authors partition the feasibility constraints on a production economy into those specific to individual firms and those linking some or all of the firms. For a large class of separable programming problems, the authors provide simple proofs of propositions on the decentralization of such problems with the help of a set of prices for resources to which the linking constraints pertain. Regarding the generality of the results, the authors note that: (1) nowhere do they require differentiability of the functions involved; (2) nowhere must the individual constraint sets be functionally specified and the first proposition assumes neither concavity of maximands nor convexity of feasible sets. Here individual feasible sets might be, say, sets of discrete points. This article could be of interest to the water researcher involved in econometric methods where separable programming problems may prove applicable. (Loeb-Rutgers)
W70-06420

AN ECONOMIC INTERPRETATION OF OPTIMAL CONTROL THEORY,
Harvard Univ., Cambridge, Mass.
Robert Dorfman.
American Economic Review, Vol 59, No 5, p 817-831, December 1969. 1 fig, 8 ref.

Descriptors: *Capital, Economics, Time.
Identifiers: *Optimal control theory, *Capital theory, Calculus of variations, Maximum principle, Accumulation, Hamiltonians, Time paths.

Capital theory is the economics of time. Its task is to explain if, and why, a lasting instrument of production can be expected to contribute more to the value of output during its lifetime than it cost to produce or acquire. For the past fifty years capital theory has been perceived as a problem in the calculus of variations. The application of this conceptual tool to capital theory remained peripheral. In its modern version, the calculus of variations is called optimal control theory and it has become the central tool of capital theory. As a result, capital theory has been so transformed that it has been renamed growth theory, and has come to deal with numerous issues that previously could not even be formulated. The author's main thesis is that optimal control theory is formally identical with capital theory and that its main insights can be attained by strict economic reasoning. This thesis is supported by deriving the principal theorem of optimal control theory (the maximum principle) by means of economic analysis. In light of the importance of capital theory to water researchers involved with planning investments and management of capital budgets this article may prove to be relevant. (Loeb-Rutgers)
W70-06429

A TECHNICAL NOTE: DISCOUNTING THE GEOMETRIC SERIES,
University of Southern California, Los Angeles; and Bendix Corp., Southfield, Mich.
Gerald A. Fleischer, and Basil Mikkalkin.
The Engineering Economist, Vol 12, No 4, p 217-228, Summer 1967. 1 fig, 1 tab, 3 ref, 4 append.

Descriptors: Interest, Computer programs.
Identifiers: *Discounting, Geometric series, Compound interest tables, Present worth, Cash flows, Constant factor, Common ratio, Present value, Convergence.

Compound interest tables have long been used for the determination of equivalent values of money amounts. However, there is one especially useful discounting factor for which no tables have been published: the present worth factor for geometric series. This paper is directed to the presentation of several tables using representative values as well as a computer program which may be used for generating additional values. There are a number of real world phenomena in which successive cash flows do not increase by a constant amount, but rather increase or decrease by a constant factor. This factor, sometimes known as the common ratio, is determined by dividing any term of a geometric progression by the preceding term. The factor developed here may be used to convert a geometric series to an equivalent present value. This may prove valuable to the water researcher interested in determining the net present value of expected future benefits of purifying water when these benefits are expected to increase over time. (Loeb-Rutgers)
W70-06440

REMARKS ON ENGINEERING ECONOMY STUDIES FROM THE VIEWPOINT OF STATISTICAL DECISION THEORY,
Massachusetts Inst. of Tech., Cambridge.
Gordon M. Kaufman.
The Engineering Economist, Vol 12, No 1, p 23-29, Fall 1966. 6 p, 3 ref.

Descriptors: *Statistics, *Economic evaluation, *Decision making, Engineering, Economics, Management, Investment, Model studies, Mathematical studies, Statistical models.
Identifiers: *Statistical decision theory, Preference functions, Utility axioms, Discount rate, Present value, Decision theory.

The main contribution of statistical decision theory to the manager is that it gives him a framework for thinking about problem that requires him to be explicit about his preferences and his judgements about uncertain events and at the same time tells him how he should behave in order to be consistent with these preferences and judgements. When economics introduces uncertainty into a problem it becomes part of statistical decision theory. Given a set of acts, a set of states, a probability measure, and a preference function (and accepting the von Neuman-Morganstern utility axioms), the engineering economist is still faced with a number of practical problems which the author outlines. Difficulty in the application of these principles is due mainly to the need of simplifying the analysis and forcing the manager to think explicitly about the variables involved. Due to the necessity of making long run decisions involving varying degrees of risk in, especially, water utility management, this article should prove to be informative. (Murphy-Rutgers)
W70-06442

AN APPLICATION OF ACTIVITY ANALYS TO DEVELOPMENT PLANNING IN THE EL RIVER AREA OF THE TENNESSEE VALLEY,
Tennessee Valley Authority, Knoxville.
Lawrence J. Mauer, and William W. Stevenson.
Land Economics, Vol 46, No 1, p 85-91, Feb 197 7 p, 1 tab, 6 ref.

Descriptors: *Long-term planning, Costs, Deman Linear programming, Optimization.
Identifiers: *Activity analysis, Elk River area Tennessee Valley.

The techniques and findings of a two-ye econometric study devoted to developme planning in the Elk River area, a subregion of t Tennessee Valley, are reported. The econom profile of the Elk River area is described. A high disaggregated linear programming model w adopted for the formulation of an optim economic development strategy for the area. Th model is oriented towards the economic develo ment of a sub-area of a national economy. Th results of the study are presented. The conclusio states that a complex of highly interrelated man facturing activities can probably be expected demonstrate greater stability in the face of chang in cost and demand conditions than a colletion individual, unrelated activities. (Grossman-Ru gers)
W70-06450

SYNTHESIS OF THE DISPERSION AN WASTE TREATMENT MODELS,
California Univ., Berkeley. Sanitary Engineerin Research Lab.
For primary bibliographic entry see Field 05G.
W70-06688

A MODEL OF PUBLIC DECISIONS ILLUS TRATED BY A WATER POLLUTION POLIC PROBLEM,
Harvard Inst. of Economic Research, Cambridg Mass.
For primary bibliographic entry see Field 05G.
W70-06690

WATER RESOURCES SYSTEMS ANALYSIS PART I: ANNOTATED BIBLIOGRAPHY O STOCHASTIC PROCESSES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow, and Dale D. Meredith.
Available from the Dept of Civil Engineering. Civ Engineering Studies, Hydraulic Engineering Serie No 19, July 1969. 80 p, 270 ref. OWRR Projects A 029-Ill and B-038-Ill.

Descriptors: *Bibliographies, *Water resources *Systems analysis, *Stochastic processes, Storag Queuing theory, Hydrology, Simulation analysis Research and development.
Identifiers: Annotated bibliographies.

An annotated bibliography of 270 references o the use of stochastic processes in water resource systems analysis studies was presented. The objec tive was to develop a practical process by which th stochastic behavior of hydrologic characteristic could be simulated. The bibliography was subdi vided into specific areas: (1) the mathematics o stochastic processes, (2) theories of storage an queues, and (3) application of stochastic processe in hydrology. Only references which had direc bearing on research objectives were selected. Th bibliography covered items of basic significance t the subject matter. (Thiuri-Cornell)
W70-06698

WATER RESOURCES SYSTEMS ANALYSIS PART II: ANNOTATED BIBLIOGRAPHY ON PROGRAMMING TECHNIQUES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow, and Dale D. Meredith.
Available from the Dept of Civil Engineering. Civi Engineering Studies, Hydraulic Engineering Serie

0, July 1969. 45 p, 121 ref. OWRR Project B-Ill.

criptors: *Bibliographies, *Water resources, tems analysis, *Linear programming, *Dynam-rogramming, Optimization, Resource alloca- Hydrologic properties, Planning.
tifiers: Annotated bibliographies.

annotated bibliography of 121 references on ramming techniques was presented. Mathe-cal formulation of hydrologic systems and the us programming techniques for the optimiza- of the systems were described. The bibliog-y entries were divided according to the ning techniques used, ie., (1) linear pro-mming, (2) nonlinear programming, (3) dynam-rogramming, and (4) other techniques. The ography covered items of basic significance to ubject matter and provided a valuable source nformation to anyone engaged in research on r resources systems analysis. (Thiuri-Cornell)
-06699

TER RESOURCES SYSTEMS ANALYSIS: T III: REVIEW OF STOCHASTIC OCESSES,
ois Univ., Urbana. Dept. of Civil Engineering.
Te Chow, and Dale D. Meredith.
ilable from the Dept of Civil Engineering. Civil neering Studies, Hydraulic Engineering Series 21, July 1969. 100 p, 84 ref. OWRR Projects A-Ill and B-038-Ill.

criptors: *Stochastic processes, *Water urces, *Systems analysis, *Hydrologic aspects, ulation analysis, Markov processes, Queueing ry, Time series analysis, Storage, Risk, Invest-t, Planning.
tifiers: Random walk.

hematical stochastic processes which have applied or have potential applicability in rologic problems and water resources planning reviewed. Practical procedures were ussed for simulating the stochastic behavior of drologic system. The stochastic processes that reviewed included the random walk, Markov cesses, queueing process, theory of storage and series analysis. The generation of synthetic rologic data from historical records was ussed. Literature in the application of hastic processes for solving water resources blems was cited and examples were given. It was cluded that stochastic methods were important the economic analysis of water resources elopment. The use of stochastic models for erating hydrologic data allows the planner of er resources systems to estimate the benefits risks associated with many alternative designs. iuri-Cornell)
-06700

TER RESOURCES SYSTEM ANALYSIS: RT IV: REVIEW OF PROGRAMMING CHNIQUES,
ois Univ., Urbana. Dept. of Civil Engineering.
Te Chow, and Dale D. Meredith.
ilable from the Dept of Civil Engineering. Civil ineering Studies, Hydraulic Engineering Series 22, July 1969. 70 p, 3 fig, 76 ref. OWRR Pro-B-030-Ill.

criptors: *Water resources, *Systems analysis, near programming, *Dynamic programming, ulation analysis, Optimization, Hydrologic ems, Planning, Mathematical studies.
ntifiers: *Geometric programming, *Game ory, *Quadratic programming.

anced methodologies for water resources nning including mathematical models of rologic systems and the various programming niques for the optimization of these systems e presented. The techniques included linear gramming, dynamic programming, geometric gramming, quadratic programming, network theory, game theory, and simulation analysis. Literature on these techniques was cited and discussed. The report offered only a brief outline of the principles involved. The techniques were explained and examples of the problems which had been studied using the techniques were given in order to provide the water resource planner with a reasonably adequate description of the available modern mathematical programming techniques. (Thiuri-Cornell)
W70-06701

6B. Evaluation Process

INFLUENCE OF MAN ON THE HYDROLOGICAL CYCLE--GUIDE TO POLICIES FOR THE SAFE DEVELOPMENT OF LAND AND WATER RESOURCES.
Food and Agriculture Organization of the United Nations.

Int Conf, Food Agr Organ U N, Agenda Item 6.4.2, Paris, France, Dec 1969. 55 p, 2 fig, 107 ref.

Descriptors: *Policy matters, Natural resources, *Water resources development, *Policy development, Land resources, Arable land, Grasslands, Irrigation, Salinity, Drainage, Water pollution, Urbanization, Soil erosion, Landslides, Watersheds (Basins), Climatology, Hydrologic data, Soil conservation, *Hydrologic cycle, Land reclamation, Bibliographies.
Identifiers: Forestry land, Developing countries.

The many sciences and technologies involved in measuring hydrological results of changes in land use are discussed. Evidence from large-scale catchment studies of experimental changes in land use, as distinct from tests on small plots, although scarce, is reviewed. Subjects discussed include forest lands, grasslands, arable lands, irrigation, salinity, swamp drainage, urbanization, water pollution, and landslides. In technically advanced countries, the pressures of economic forces are rewarding the good and penalizing the bad land-use policies so that progressive improvement is occurring. Water pollution control, the most serious problem, will be achieved only at high cost with the support of strong public opinion. In the developing countries, rapid increases of population are resulting in an unplanned proliferation of subsistence agriculture, without the means of the discipline to protect the natural resources of vegetation, soils, and water. Provision of fertilizers and improved seeds, their local distribution, and provision of financial credit to permit their use are recommended to combat soil erosion. Discipline in the use of water resources for irrigation and their protection from pollution is advised; education alone is ineffective. (USBR)
W70-06370

GROUNDWATER RESEARCH IN THE U.S.A.,
Geological Survey, Washington, D.C. Water Resources Div.
C. L. McGuinness.
Earth-Science Reviews, Vol 3, No 3, p 181-202, September 1967. 22 p, 3 tab, 22 ref.

Desriptors: *Water resources development, *Groundwater, *Research and development, Injection wells, Transmissivity, Water level fluctuations, Water yield, Governments, Universities, Groundwater movement, Systems analysis, Model studies, Water resources research act.
Identifiers: Water resources research, Groundwater research.

Groundwater reservoirs and the overlying unsaturated zone have an enormous capacity to supply water to wells and useful plants, to store water to meet future needs, and to accept wastes. This capacity can be exploited on a maximum scale, however, only on the basis of information one or more orders of magnitude greater than that available at present on the distribution, recoverability, and replenishability of subsurface water. There is a critical need for research to devise methods of accomplishing these water-management tasks at reasonable cost. Among the chief target areas for research in subsurface hydrology are permeability distribution, including vertical permeability; prediction of the true value of the storage coefficient; theory of unsaturated flow based on fundamental soil characteristics that can be measured practicably; geochemical relations including the effects of injecting water of one composition into zones occupied by waters of different composition, generation of acid mine water, occurrence of saline water, and salt-fresh-water relations in coastal and other areas; prediction of the fate of wastes injected underground; geophysical techniques; and practical techniques of artificial recharge, especially through wells. (Knapp-USGS)
W70-06402

GEOLOGICAL INFORMATION FOR MANAGING THE ENVIRONMENT,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 06G.
W70-06403

ECONOMIC PROBLEMS IN SEPARATING THE DETERMINANTS OF RELATIVE PRICES,
Vanderbilt Univ., Nashville, Tenn.
G. S. Sahota.
International Economic Review, Vol 10, No 2, p 183-201, June 1969. 23 p, 21 ref, 6 tab.

Descriptors: *Prices, *Competition, *Monopoly, *Economic efficiency, Economic evaluation, Technology, Resource-allocation, Consumption, Industrial production, Marginal cost, Labor, Demand, Least-squares regression, Gross National Product, Value, Capital cost, Mathematical study, Costs.
Identifiers: *Oligopoly, *Technical progress, Internal competition.

There has been considerable discussion recently on the economic efficiency of the water utility industry in the context of public vs. private ownership and its affect on the consumer. This study should clarify some of the problems involved in this issue. A method is developed to separate the effects on the relative price of a product of relative intrafirm technical progress, interfirm resource-allocation improvements, scale economies and changes in input prices, on the one hand, from the effects associated with relative changes in internal competition or competition in the production of the product and external competition or competition in the consumption of the product. The method was applied to an empirical study of the oligopolistically controlled U.S. sulfur industry. The study indicated that a nine percentage point decline in the degree of monopoly resulted from an increase of internal competition. A reduction of about forty percentage points in the potential degree of monopoly was due to an increase of external competition. (Murphy-Rutgers)
W70-06408

FEDERAL AID TO THE STATES: AN ANALYTICAL EXAMINATION OF THE ALTERNATIVES,
Washington Univ., St. Louis, Mo.
For primary bibliographic entry see Field 05G.
W70-06410

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
University of Southern Mississippi, Hattiesburg.
D. L. Williams, and Donnie L. Daniel.
Water Resources Bulletin, Vol 5, No 3, p 50-56, September 1969. 7 p.

Descriptors: *Economic analysis, *Floods, *Water resource development, *Hurricanes, *Value, *Duration, Probability, Risks, Long-term planning,

Short term planning, Statistics, Damages, Costs, Conservation, Decision making.
Identifiers: *Expected value, *Natural disasters, *Time span.

There are two factors that influence the acceptability of the expected value criterion as a method of handling risk or uncertainty in decision making where damages from unusual physical occurrences such as hurricanes or floods must be considered. The length of time of project existence and the problem of obtaining accurate estimates of the probability of occurrence for different sizes of natural disasters must be solved. The latter problem is shown to be solvable with the probabilities not as high so as to make the use of the expected value criterion unwarranted. The time span of the project is more difficult. For projects with a continual, or long-term existence, the expected value approach is highly applicable. However, as a project becomes more short-term in nature, it is more a situation of uncertainty than one of risk. Therefore, the applicability of the expected value criterion for short-term analysis is suspect. (Murphy-Rutgers)
W70-06411

OPTIMAL PLANT UNDER CONDITIONS OF RISK,
Wesleyan Univ., Middletown, Conn.
T. M. Whitin.
Journal of Industrial Economics Vol XVII, No 2, p 81-85, April 1969. 5 p, 2 tab, 11 ref.

Descriptors: *Risks, *Probability distribution, *Economic evaluation, *Model studies, Demand, Interest rate, Costs, Optimization, Inventory, Uncertainty, Statistics, Economics.
Identifiers: *Optimal plant, *Production policy, Cost functions, Flexible plant, Entrepreneur, Time horizon.

The entrepreneur cannot select his optimal plant without explicit consideration of price, the probability distribution of demand, inventory level, and the discount rate. An optimal dynamic production policy is needed which indicates the optimal level of production for each level of initial inventory before an optimal plant selection can be accomplished. This indicates the impossibility of separating the cost and demand components of economic analysis. The model used to illustrate this theory is a stationary dynamic model with infinite time horizon, specified price, discount rate and two different plants represented by two simple and discrete cost functions. The model indicates that selection of an optimal plant depends on price level, demand, discount rate and production policy as well as the costs of alternatives studied in conventional economic analysis. This method serves as an optimizing procedure in the presence of risk, and is thus pertinent to the area of water resources where decisions on the optimal plant size are affected by the factors discussed in this article. (Murphy-Rutgers)
W70-06412

RETURNS TO SCALE, EULER'S THEOREM, AND THE FORM OF PRODUCTION FUNCTIONS,
Georgetown Univ., Washington, D.C.
F. W. McElroy.
Econometrica Vol 37, No 2, p 275-279, April 1969. 5 p, 3 ref.

Descriptors: *Economic analysis, *Mathematical studies, *Industrial production, Economic efficiency, *Input-output analysis, Economics of scale, Capital costs, Elasticity, Costs.
Identifiers: *Production functions, *Econometrics, *Euler's Theorem, Returns to scale, Homogeneity, Expansion paths.

By generalizing on Euler's Theorem, one can explain the classes of production functions for which scale elasticity depends either on output level alone or on factor proportions alone. Three classes of functions for which the nature of returns to scale, although not characterized by a single constant, can be described in terms of a function of a single variable. The analysis shows that the class of functions satisfying the first equation consists only of homogeneous functions and that those satisfying the second equation behave like homogeneous functions along each ray but the degree of homogeneity varies from ray to ray. The class of functions satisfying the other are the production functions for which all expansion paths are straight lines through the origin. The importance of understanding the production function in economic studies of the water supply industry makes this relevant reading for the water researcher. (Murphy-Rutgers)
W70-06413

FINANCING WATER UTILITY TRAINING,
Mahoning Valley Sanitation District, Youngstown, Ohio.
Donald D. Heffelfinger.
Journal of the American Water Works Association Vol 61, No 9, p 476-479, September 1969. 4 p.

Descriptors: *Financing, *Training, *Public utilities, *Costs, Technology, Economic efficiency, Education, Government, Management, Safety, Water supply, Schools, Instruction, Employment opportunities, Human resources.
Identifiers: *Water utilities, *Human capital, Manpower, Skills, Labor costs, Training costs.

Education and training results in the most effective use of manpower in the water utility industry. Rapid technological change brings prosperity and opportunity but it also brings problems of adjustment and demands for more knowledge. Continuous training of all water utility employees is needed for adaptation to technical changes. The government is aware of this need and is beginning to provide funds for training. Industry has long been aware of the problem and has provided for it, as have many large water utilities. The author states that the high cost of training should be considered a legitimate cost of operation and included in every operating budget, since it leads to greater economic efficiency. A breakdown of all the factors involved in training costs is given. The author feels that the number of personnel receiving training should be expanded. (Murphy-Rutgers)
W70-06414

SPECTRAL ANALYSIS OF DATA GENERATED BY SIMULATION EXPERIMENTS WITH ECONOMETRIC MODELS,
Duke Univ., Durham, N.C.
Thomas H. Naylor, Kenneth Wertz, and Thomas H. Wonnacott.
Econometrica, Vol 37, No 2, p 333-352, April 1969. 20 p, 46 ref.

Descriptors: *Economic evaluation, *Statistics, *Computers, Time series, Model studies, Economics, Mathematical studies, Income, Simulation analysis, Economic analysis, Probability, Stochastic processes, Estimation, Demand.
Identifiers: *Spectral analysis, *Econometrics, Confidence limits, Maximum likelihood.

The potential value of spectral analysis as a technique for analyzing data generated by computer simulation experiments with econometric models is demonstrated. The widespread use of this type of simulation in many water resource studies makes this article useful to the water researcher. By constructing the appropriate confidence bands, spectral analysis enables one to validate the output of simulation experiments and to compare the results of alternative economic policies associated with different series generated by an econometric model. The article discusses differences in the application of spectral analysis to series generated by computer simulation experiments and the application of spectral analysis to real world economic series. (Murphy-Rutgers)
W70-06416

NATURAL RESOURCE INFORMATION FO ECONOMIC DEVELOPMENT,
Resources for the Future, Inc., Washington, D.C.
Orris C. Herfindahl.
Baltimore, Maryland, The Johns Hopkins Pre 1969. 212 p.

Descriptors: *Costs, *Hydrologic aspects, *Dat *Data processing, *Economic evaluatio *Planning, *Surveys, Hydrologic data, Budgetin Mapping, Geological surveys, Aerial mappi Streamflow, Statistics, Health, River basin develo ment, Statistical model, Floods, Natural resour development, Interest rate, Irrigation, Satellit Land use, Regional analysis.
Identifiers: *Hydrologic gauges, *Econom development, Soil surveys, Mineral explorati Agricultural surveys.

The problems involved in managing governmen programs that generate information about natu resources are studied. These problems are co sidered in relation to the more general problem promoting economic development. There is discussion of the role of natural resources economic development, including an analysis the process by which information comes to generated and related to decisions on investme and production. The author then proceeds to amine some of the ways of gaining informati about natural resources along with the capabilit and limitations of that information and the cost acquiring it. Some guidelines for decisions on na ral resource information programs are propose with consideration of the topics of time and t productivity of capital, location, and other facto needed to make effective use of natural resour information. Organizational problems discussed in general terms as well as with special tention to the problems of some small countri The importance of water resources in the natu resource area makes this book of interest to t water resource planner. (Murphy-Rutgers)
W70-06418

SOME NOTES ON THE ELASTICITY OF SU STITUTION,
Colorado Univ., Boulder.
Frank S. T. Hsiao.
American Economic Review, Vol LIX, No 3, 432-435, June 1969. 4 fig, 7 ref.

Descriptors: Economics, Capital.
Identifiers: *Elasticity of substitution, Curvatu Factor space, Production function, Uneconom region.

The first part of this paper demonstrates that t use of the concept of curvature is useful checking some properties of the elasticity of su stitution between two factors. In particular, it shown that C S Soper's recent discussion on t elasticity of substitution in a noneconomic regi can be derived easily from the method present here. The second part of the article illustrates t elasticity of substitution in a per capita output-p capita capital diagram. The author contends th this may be thought of as a counterpart to Ron Jones' diagram in his article found in the Americ Economic Review, September 1965. This arti may be of value to the water researcher attempti to find the elasticity of substitution between facto used in water production and supply functio (Loeb-Rutgers)
W70-06421

BEHAVIOR OF THE FIRM UNDER REGUL TORY CONSTRAINT,
Purdue Univ., Lafayette, Ind.
Akira Takayama.
American Economic Review, Vol LIX, No 3, 255-260, June 1969. 1 fig, 8 ref.

Descriptors: Regulation, Constraints, Investme Capital.
Identifiers: *Firm, *Regulation constraint, Rate return, Regulated industries, Marginal products.

n a recent article H Averch and L O Johnson, writ-ng on the fair rate of return regulation in public tilities industries (or more generally 'regulated' in-ustries), argue that the introduction of an 'active' onstraint of a fair rate of return type would induce he firm to invest more than the original profit max-mization value of capital, and this would create an nefficient allocation of inputs. The present author ontends that Averch and Johnson's arguments are ketchy and contain somewhat ambiguous logic at everal points. Although the author agrees with heir conclusion, that a firm will tend to increase its nvestment with the introduction of an active con-traint, he argues that it does not follow from their rguments. The author contends that a serious rror arises from confusing movements along a urve and shifts of a curve. The present article larifies those ambiguities and corrects the nistakes. A new formulation of the problem is pro-ided which gives the same answer as Averch and ohnson, namely that a firm will tend to invest nore with the introduction of an active constraint. This concept may prove helpful in the water area y indicating the effect of regulation on invest-nent. (Loeb-Rutgers)
W70-06422

OUTPUT OF THE RESTRAINED FIRM,
Ohio State Univ., Columbus.
Milton Z. Kafoglis.
American Economic Review, Vol LIX, No 4, p 583-589, September 1969. 2 fig, 6 ref.

Descriptors: Prices, Monopoly, Costs, Profit, In-come, Welfare.
Identifiers: *Output, *Restrained firm, Price dis-crimination.

The price and output behavior of the restrained monopoly firm are examined. H Averch and L Johnson have examined the impact of a regulatory restraint on the behavior of the monopoly firm whose management has a preference for profits. Models describing firms which voluntarily restrain profits have been developed by O. Williamson under the assumption of a managerial preference for expense and by W. Baumol under the assump-tion of revenue preference. These alternative for-mulations of the restrained firm reveal wide varia-tions in price and output behavior. However, they do not reveal the range of possibilities when costs are increasing, when the firm seeks to maximize output or scale of operations, or when the firm em-ploys price discrimination. Under these circum-stances the output of the restrained monopoly may exceed that predicted by existing models and may even be pushed beyond an optimum as a result of sales at prices below marginal costs. This predic-tion of excess monopoly output, even in restrained or regulated situations, is the opposite of what we generally expect. This article may prove useful in the water area where 'firms' are restrained with respect to prices and rates. (Loeb-Rutgers)
W70-06423

PARETO OPTIMAL REDISTRIBUTION,
Virginia Univ., Charlottesville; and Pennsylvania State Univ., State College.
Harold M. Hochman, and James D. Rodgers.
American Economic Review, Vol LIX, No 4, p 542-557, September 1969. 5 fig, 7 tab, 13 ref.

Descriptors: *Taxes, Progressive taxes, Income, Welfare, Transfer.
Identifiers: *Pareto optimality, *Redistribution, In-come redistribution, Utility interdependence, Tax burden, Fiscal incidence, Efficiency, Transfer-elasticity.

On trying to reconcile income redistribution with consumer sovereignty and an individualistic in-terpretation of the fiscal and political processes, the authors experimented with alternative hypotheses about utility interdependence. In the presence of such interdependence, Pareto op-timality may not only be consistent with redistribu-tion, but may require it. If so, the necessary fiscal adjustments depend on the implicit transfer-elasticities and the shape of the size distribution of income. Pursuing this line of thought, the authors have calculated, for several situations, the patterns of tax burdens, transfers, and fiscal incidence that would be Pareto optimal. The authors also tried to determine the type of utility interdependence that is implied by the actual fiscal residuals prevailing in the United States in 1960, on the assumption that those residuals were Pareto optimal. This may prove relevant in the water area in the event that income redistribution effects the demand for water, and also to the extent that water investments have distributional effects. (Loeb-Rutgers)
W70-06424

ATTITUDE DIMENSIONS OF LEISURE,
City Coll., New York.
John Neulinger, and Miranda Breit.
Journal of Leisure Research, Vol 1, No 3, p 255-261, Summer 1969. 1 tab, 10 ref.

Descriptors: *Attitudes, Recreation, Psychological aspects.
Identifiers: *Leisure, Attitude dimensions, Work, Free time, Factor analysis, Leisure planning.

The authors are not concerned with leisure activi-ties per se, but rather in how people want to spend their money and how much satisfaction they get from spending it. The authors are not concerned with establishing a definitive meaning of leisure but rather with determining what leisure means to dif-ferent people. Accordingly, this paper investigates people's attitudes toward leisure. Since a person's attitude tends to be part of his integral value system, the authors include in their investigation concepts closely related to leisure such as work, free time, and recreation. The purpose of this paper is to report on the construction of an instrument designed to measure leisure attitudes. Results of the anlysis indicate seven dimensions in which peo-ple may differ in their attitude toward leisure. This type of analysis concerned with attitude towards leisure can be helpful to the water researcher con-cerned with managing and predicting future needs for outdoor recreation facilities that involve water oriented recreation activities. (Loeb-Rutgers)
W70-06425

COMPUTER GRAPHICS FOR DECISION MAK-ING,
International Business Machines Corp., Poughkeepsie, N.Y.
Irving M. Miller.
Harvard Business Review, p 121-132, November-December 1969. 6 fig.

Descriptors: *Decision making, Computers, Costs, Demand, Profit, Industrial production.
Identifiers: *Computer graphics, Graphs, Display system, Electronic aids, Marginal revenue.

Computer graphics for business decision making is a relatively new technique whereby an executive creates and analyzes graphs relating to business decisions by direct interaction with a computer that has been programmed to produce these curves on a visual output screen. Graphic techniques have been used for some time by engineers and designers to analyze complex shapes. What is new today is the ability of computer programs to analyze economic and business decisions for executives who need not know how to manipulate complex mathematics. In most instances required programming skills are well within the capabilities of any corporation using computers. As such, computer graphics may prove to be very helpful to the water manager in aiding in the decision making process. Part I of this article describes the salient points of the graphic technique, and it demonstrates through illustra-tions how problems can be analyzed by computer graphics. Part II describes the actual display system and discusses the function and respective merits of standard electronic aids. Suggestions for develop-ing programs and software requirements are given, along with estimates of the size of system needed. (Loeb-Rutgers)
W70-06427

BRINGING RESOURCE CONSERVATION INTO THE MAIN STREAM OF AMERICAN THOUGHT,
Forest Service (USDA), Ogden, Utah.
S. Blair Hutchinson.
Natural Resources Journal, Vol 9, No 4, p 518-536, October 1969.

Descriptors: *Conservation, Resources, Natural resources, Employment, Costs.
Identifiers: Resource conservation, Awareness, So-cial problems, Resoource problems, Resource management, Rural economies, Renewable resources, Resource values.

The failure of the United States to efficiently han-dle its natural resources is discussed. This failure has developed in large part from the lack of broad public awareness of what is happening with the consequent failure to develop strong programs for dealing with social and resource problems. The op-position of those using the resources who would be disadvantaged by more effective conservation poli-cies has also been important. The thesis behind this paper is that the failure of the American people to respond more aggressively to the needs of conser-vation is primarily because the issues have never been properly described. The author presents three needs which should be fulfilled: (1) to relate the renewable natural resources and their management to the goals of our society; (2) to develop and gain acceptance of a comprehensive code defining the responsibility of society in relation to its resources; and (3) to develop clear objectives as anchor points for management decisions. These objectives would all be consistent with management programs in the water area. (Loeb-Rutgers)
W70-06428

LONG-RUN SCALE ADJUSTMENTS OF A PER-FECTLY COMPETITIVE FIRM AND INDUS-TRY,
Texas A and M Univ., College Station.
C. E. Ferguson, and Thomas R. Sauing.
American Economic Review, Vol 59, No 5, p 774-783, December 1969. 2 fig, 8 ref, 1 append.

Descriptors: *Competition, Expenditures, Prices, Marginal Costs, Average costs, Supply, Demand.
Identifiers: *Long-run scale adjustments, *Perfect competition, Output, Elasticity, Expenditure elasticity, Factor price, Supply price, Income elasticity, Substitution effect, Expenditure effect, Income effect.

The objective is to prove the following propositions for perfectly competitive firms and industries: (a) a firm's short- and long-run output adjustment to a change in factor price depends upon the expendi-ture elasticity of the factor, not upon its normality or inferiority; (b) regardless of the change in mar-ginal cost, average cost must vary directly with fac-tor price; (c) hence the long-run supply price of a perfectly competitive industry must vary directly, and its output inversely, with factor price. The authors also show that (a) from the production side, the relation between supply and expenditure elasticity is analogous to the relation between de-mand and income elasticity in the theory of con-sumer behavior; (b) derived input demand func-tions have substitution and expenditure effects that are analogous to the substitution and income ef-fects in the theory of demand; and (c) long-run average cost is always inelastic with respect to fac-tor price. Theoretical micro economic analysis is employed to discuss the problems of the water 'market.' The article contributes to the basic un-derstanding of micro theory and is relevant to theoretical presentations of economic issues in water supply and demand problems. (Loeb-Rut-gers)
W70-06430

TOWARD A THEORY OF MULTIPLE USE: THE CASE OF RECREATION VERSUS AGRICULTURE,
British Columbia Univ., Vancouver.
Peter H. Pearse.
Natural Resources Journal, Vol 9, No 4, p 561-575, October 1969. 3 fig.

Descriptors: *Recreation, Income, Resource allocation, Competing uses, Ranges, Cattle, Deer, Investment, Benefits, Natural resources, Welfare.
Identifiers: *Multiple use, Transformation curve, Resource improvement, Resource management.

The problem of simultaneous and conflicting uses of a natural resource is discussed. The assumed objective has been one of maximizing the contribution of the resource to the welfare of the social group in whose interest it is managed. The author demonstrates the kind of information required to fix the socially-optimum combination of conflicting uses of a resource. As increasing demands are placed on rural resources, there will be more and more cases in which the most efficient management regime will involve providing for two or more uses at once. There appears, therefore, to be an urgent need to clarify the criteria for establishing optimum combination of uses. This article attempts to throw some light on the conceptual problems involved. The author argues that these problems suggest a wide scope for research bringing together the combined expertise of biologists and economists. The theory of multiple use may find wide applications in the water area where often water facilities are competitive in more than one use. (Loeb-Rutgers)
W70-06431

ON THE SOCIAL RATE OF DISCOUNT: COMMENT IV,
Missouri Univ., Columbia.
David D. Ramsey.
American Economic Review, Vol 59, No 5, p 919-924, December 1969. 6 ref.

Descriptors: Discount rate, Taxes, Risks.
Identifiers: *Social rate of discount, Weighted average, Rate of return, Time preference.

Using the formula developed by Baumol, the author shows that his conclusions are special cases of a general case. The following results emerge from the analysis: (1) the social rate of discount is a weighted average of observable pre-tax market rates of return and is not directly observable. The 'weights' depend on how individuals in the private sector react to the transferral of resources. (2) Both risks and time preferences are given their appropriate consideration in this 'weighting' process and neither need to be explicitly considered again. The question about what is the appropriate rate of discount then becomes an empirical one. Section I analyzes the social rate of discount when there are no risks in the economy and time preferences are ignored. Risks are introduced in Section II and time preferences in Section III. This discussion is relevant to questions concerning what discount procedure to use for water investment projects. (Loeb-Rutgers)
W70-06432

ON THE SOCIAL RATE OF DISCOUNT: COMMENT I,
Central Michigan Univ., Mount Pleasant.
Alan Nichols.
American Economic Review, Vol 59, No 5, p 909-911, December 1969. 3 ref.

Descriptors: Taxes, Distribution patterns.
Identifiers: *Social rate of discount, Time preference rate, Opportunity cost, Consumption, Rate of return, Borrowing.

The author contends that the recent article by W. J. Baumol errs in the handling of social opportunity costs. Baumol concludes that if r is the public's time preference rate for consumption, 2r will be the opportunity cost of transfer. The author objects to the idea that it makes no difference whether resources are transferred by borrowing or by taxation. The difference between attracting resources from consumption, as would be the case with taxation, and attracting resources from saving, as in the case with government security issue, is that a larger quantity of resources would be passed to the future if the taxation route is followed. Thus, if the question is the shift of resources to future generations, it does make a difference which route is taken. The different routes have different distributional consequences among generations. The author also contends that the correct rate to use in Baumol's framework is the opportunity rate, 2r. The social discount rate plays an important role in evaluating water resource investments and this article is relevant to researchers concerned with the role of the discount rate in water projects. (Loeb-Rutgers)
W70-06433

ON THE SOCIAL RATE OF DISCOUNT: COMMENT II,
State Univ. of New York, Stony Brook.
Estelle James.
American Economic Review, Vol 59, No 5, p 912-916, December 1969. 1 fig, 5 ref.

Descriptors: Taxes, Marginal return, Investment, Interest, Risks.
Identifiers: *Social rate of discount, Corporate income tax, Time preference, Opportunity cost, Consumption.

In Baumol's recent article, the corporate income tax is shown to create a divergence between the marginal rate of return to private investment, on the one hand, and the subjective time preference or government borrowing rate, on the other. Baumol claims that the former constitutes the opportunity cost of capital and hence the optimal social discount rate for evaluating public projects whether the resources used have been diverted from private investment or consumption. The author presents an anlysis which suggests somewhat contrasting conclusions. This article is relevant to water investment projects using the social discount rate concept. (Loeb-Rutgers)
W70-06434

NATURAL LANDSCAPE PREFERENCES: A PREDICTIVE MODEL,
Forest Service (USDA), Syracuse, N.Y.
Elwood L. Shafer, Jr., John F. Hamilton, Jr., and Elizabeth A. Schmidt.
Journal of Leisure Research, Vol 1, No 1, p 1-19, Winter 1969. 4 fig, 3 tab, 4 ref.

Descriptors: *Forecasting, Photography, Natural resources, Preferences, Regression analysis.
Identifiers: *Natural landscape preferences, Landscape.

In trying to cope with the problem of landscape abuse and destruction, one of the questions that natural resource planners frequently ask is: 'Why is one landscape preferred more than another.' An experiment was recently conducted using black and white photographs of landscapes. The purpose of the study was to identify what quantitative variables in a natural landscape are significantly related to public preference for that landscape. By knowing what quantitative features in a landscape affect its aesthetic appeal, natural resource planners can make decisions on a factual basis about purchasing, developing, or preserving these features. The experiment indicates that preference for a landscape depends on the area or perimeter measurements of six items within a photograph. These six photographic items can be measured easily by resource planners, and can be used to help evaluate and compare the aesthetic quality of different landscapes. The method is applicable in many areas of natural resource management and planning, from wilderness aesthetics to scenic road designs. This may prove helpful to the water researcher in attempting to determine, for example, how much and what type of water resource to develop for rec tion purposes. (Loeb-Rutgers)
W70-06435

A TECHNIQUE FOR DETERMINATION PROJECT PRIORITY WHEN CONSIDERI IRREDUCIBLES,
University of Southern California, Los Angeles.
Gerald A. Fleischer.
The Engineering Economist, Vol 11, No 2, p 13
Winter 1966. 17 p, 27 ref, 6 tab.

Descriptors: *Economic evaluation, *Economic ficiency, Engineering, Investment, Costs, Optim tion, Priorities, Value, Marginal utility, Mone value, Decision making.
Identifiers: *Irreducibles, Simple order, Order distribution, Numerical scale, Utility, Lexiograp ordering, Pareto optimality.

In addition to the inclusion of economically m surable consequences of prospective alternative all engineering-economic analysis, those c sequences which cannot feasibly be reduced monetary terms should also be considered. T paper suggests a technique which can be used to clude irreducibles along with monetary data determining relative desirability of mutually ex sive alternative proposals. The author discusses three degrees of measurement possible; sim order, order on distances and a numerical sc The article explains each, and provides several amples of each. The author feels that it is impo ble to generate single-valued numerical proper which reflect true utility but this is not disastr since the engineering-economist may be con with the establishment of priorities, not values. T article should aid in the economic evaluation o ternative water resources projects which have ficulty in evaluating the monetary benefits sociated with all their uses. (Murphy-Rutgers)
W70-06436

AN EXPERIMENTAL ASSEMBLY LI SYSTEM FOR EVALUATING POTENTIAL VESTMENTS,
California Univ., San Diego, La Jolla, Calif.
Richard L. Norgard.
The Engineering Economist, Vol 11, No 2, p 29
Winter 1966. 19 p, 6 ref.

Descriptors: *Economic evaluation, *Investm *Decision making, *Forecasting, Economic ciency, Value, Marginal cost, Capital, Optim tion, Cost minimization, Budgeting, Inco Statistics, Model studies, Demand, Monte C study, Frequency distribution, Average cost, gineering, Management, Risks.
Identifiers: *Assembly-line method, *Rate return, *Einheits.

This article seeks to develop a model for system cally evaluating capital expenditures which maximize the reuse of data and analyzes from proposal to another, utilize the talents of the en organization, and systematically measure un tainty. The article is also concerned with descri the reaction of business managers to the m after it had been experimentally applied t specific potential investment project. The au proposes an assembly-line system, which is sh to handle capital budgeting problems efficie and makes a substantial improvement in the qua and quantity of analysis. Once this method is ganized, the marginal cost of analyzing investm is small. This method could prove applicabl evaluating techniques of water resource investm projects. (Murphy-Rutgers)
W70-06438

EVALUATION OF INVESTMENTS IN WA RESOURCES MANAGEMENT,
Wisconsin Univ., Madison. Water Resou Center.
Irving K. Fox.
American Water Works Association Journal, 59, No 8, p 913-918, August 1967.

scriptors: *Economic evaluation, *Political ects, Water resources, Investment, Govern- nt, Financing, Flood control, Benefits, Value, nagement, Income, Transportation.
ntifiers: *Program alternatives.

st literature that attempts evaluation of water ource programs in the United States is cited. ese studies have not been entirely successful and limitations of the techniques of economic anal- s are discussed. An important problem discussed re is that of making information available to the blic in order to make value judgments. In addi- n, the four major obstacles preventing the esentation of alternatives for public considera- n are discussed along with the kinds of measures ich will aid in their solution. The author feels at evaluation of public programs in the final anal- s is a political function. Attention should be en to improving the capability of the political in- tution to perform its evaluation function. lurphy-Rutgers)
70-06439

CONOMIC COMPARISON OF PROJECTS IN- ORPORATING A UTILITY CRITERION IN HE RATE OF RETURN,
alifornia Univ., Los Angeles.
M. English.
he Engineering Economist, Vol 10, No 2, p 1-14, inter 1965. 2 fig, 8 ref.

escriptors: *Risks, Decision making, Economics, osts, Income, Investment, Probability.
entifiers: *Economic comparisons, *Utility, Rate of return, *Discount function, Decision eory, Present worth, Engineering economy.

conomic analyses of engineering projects have ually been made on the basis of deterministic ethods of traditional engineering economy. Only cently have serious attempts been made to in- oduce aspects of risk and uncertainty explicitly to the methodology. The new methods are based n the principles of decision theory. The purpose of is paper is to develop a discount function by hich future money prospects can be weighted for urposes either of economic comparison of com- eting investment opportunities, or of evaluation of projected undertaking. This discount function kes account of risk which is related to the utility nction of the investor. It considers his attitude ward risk and his preference for safe or risky in- estments. This article would be applicable to the ater area where investment decisions clearly con- in uncertainties and risks. (Loeb-Rutgers)
70-06441

ENSITIVITY ANALYSIS--A CASE STUDY OF HE PIPELINE INDUSTRY,
exas A and M Univ., College Station.
illiam C. House, Jr.
he Engineering Economist, Vol 12, No 3, p 155- 66, Spring 1967.

escriptors: *Capital, *Investment, *Decision aking, Risks, Costs, Income.
dentifiers: *Sensitivity analysis, Pipeline industry, ates of return.

apital investment decisions are among the most ritical decisions that management must make. ecisions by the management of business firms for nvestment capital are often made largely on the asis of whether estimated rates of return are ac- eptable or not. Errors by management in estimat- ng such underlying elements as sales volume, sales rice, operating expenses, and project economic fe may cause estimated rates of return to be igher or lower than actual rates of return. Errors estimates can not be totally eliminated. It is ossible, however, to determine the significance of uch errors and thereby more clearly identify the sks involved in accepting a given investment roposal. It is likely that decisions to accept pecific proposals in a number of industries are sen- itive to errors in only a few of the many estimates hich are used to calculate rates of return. If it can be established that the decisions to accept a given type of proposal are sensitive to errors in certain estimates, then management can concentrate its data-gathering and evaluation efforts on these estimates and thereby obtain the greatest improvement in capital investment decision making for the least expenditure of time and money. For example, an illustrative capital investment decision in the oil and pipeline industry is presented. This paper would be of interest to the water researcher or planner involved in investment decisions. (Loeb-Rutgers)
W70-06443

THE ECONOMIC IMPACT OF TVA.
Tennessee Univ., Knoxville.

Edited by John R. Moore. Knoxville, University of Tennessee Press, 1967. 163p.

Descriptors: *Economic impact, *TVA, *Water resource development, *Natural resource development, Cost benefit analysis, Decision making, Economic analysis, Industrial production, River basin development, Multipurpose projects, Planning, Capital, Prices, Watersheds, Costs, Social aspects, Management, Flood control, Irrigation, Pollution, Recreation, Transportation.
Identifiers: *Underdeveloped areas, Agricultural extension, Economic development.

This volume begins with a consideration of the general guestion of the role of electrical energy in economic development and continues with a discussion and evaluation of the role that TVA has played in a number of important areas of transferring knowledge to underdeveloped areas, in developing natural resources, in illustrating the politics of water resource development and in the area of antitrust. Two papers attempt to assess in broad terms where TVA has been and to indicate possible lines of further development. The final essay is an inquiry into TVA's future, by its board chairman. He examines the potential contribution which TVA can make for the benefit of the people of the Valley region and of the nation as a whole. (See also W70-06445 and W70-06446). (Murphy-Rutgers)
W70-06444

TOWARD MORE REALISTIC ASSUMPTIONS IN REGIONAL ECONOMIC DEVELOPMENT,
Tennessee Univ., Knoxville.
Gilbert Banner.
The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967, p 121-143. 23 p.

Descriptors: *TVA, *Regional analysis, *Economic evaluation, Planning, Rivers, Multipurpose projects, Government, Income, Electric power, Agricultural production, Irrigation, Fertilizer, Costs, Employment, Navigation, Transportation, Water supply, Technology, Watersheds, Engineering, Economic analysis, Social aspects.
Identifiers: *Regional economic development, Federal agencies, Agricultural policy, Welfare economics, Industrial sites, Highway location.

This article is concerned with the problem of evaluating the TVA. The author, although sympathetic to TVA in its overall conception, raises a number of questions concerning the direction, scope and force of the TVA's activities. In many areas he finds shortcomings in the TVA record. The assumptions made by TVA concerning regional economic development were proved wrong and the TVA failed to make the necessary adjustments. The federal government has begun to assume its share of responsibility for the problems resulting from changes in the national economy and the policy options open to the TVA for regional economic development are discussed. The objectives to be pursued in the agricultural policy are outlined and the TVA's interest in the tributary watershed program is explained. The author feels that if regional resource development is to be pursued, substantial changes may be necessary in the institutional arrangements through which such problems are approached. (See W70-06444). (Murphy-Rutgers)
W70-06445

THE FUTURE OF TVA,
Tennessee Valley Authority, Knoxville.
Audbrey J. Wagner.
John R. Moore, Editor, The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967. P 145-160, 16P.

Descriptors: *TVA, *Pollution, *Flood control, *Transportation, *Recreation, *Economic analysis, Streams, Water supply, Waste, Treatment, Government, Electric power, Economic efficiency, Rivers, Planning, Forestry, Costs, Agricultural production, Income, Employment.
Identifiers: *Tennessee Valley, *Shoreline land, Zoning.

This paper examines the potential contribution which TVA can make for the benefit of the people of the Valley region and the nation as a whole. These benefits embrace a number of specific areas: electric power, development of industrial and recreational sites, the orderly development of lakeshore lands, flood control, forestry and agriculture. These areas are evaluated and explained in terms of the potential contribution of TVA in achieving the specified goals in the most economically efficient manner. The economic benefits arising out of past TVA policy are discussed both as testimony to the success of TVA and as an indicator of the problems still facing that agency. An observation is made that there are more highly developed institutions now available for dealing with the problems of a publically operated agency than were previously available. The obvious role of water use and development in the TVA experience make this article relevant to the water study area. (See W70-06444). (Murphy-Rutgers)
W70-06446

A CRITICAL ANALYSIS OF EMPLOYMENT PROJECTION METHODS: A TEST CASE OF NEW JERSEY,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Daryl Hellman, and Matityahu Marcus.
Available from the Clearinghouse as PB-191 716, $3.00 in paper copy, $0.65 in microfiche. Partial Completion Report, May 1970. 225 p, 24 tab, 112 ref, 2 append. OWRR Project B-002-NJ (3).

Descriptors: *Statistical methods, Population, Employment, Growth rates, Regression analysis, Input-output analysis.
Identifiers: *Projection.

This study develops projections of employment to 1975 for SIC three-digit manufacturing industries in New Jersey. Some attention is devoted to the possibility of projections by regions of the state, but projections are not derived. The study begins with a brief review of approaches to regional analysis, followed by a detailed discussion of regional projection methodology, development of an explicit shift-share model of projection for New Jersey, and evaluation of the employment projections derived from the model via comparisons with other projection techniques. The comparisons suggest that the explicit shift-share approach is a reliable method for projecting employment in local market-oriented industries. For export industries the model does not perform as well as other, simpler models. Reasons for the relative performances are discussed. This study was prepared for purposes of water resources research. (Hellman-Rutgers)
W70-06448

REVIEW OF NEW GEOGRAPHIC METHODS AND TECHNIQUES. QUESTIONNAIRE SURVEY. WATER RESOURCE PLANNING AND MANAGEMENT. RECENT TRENDS IN REMOTE SENSING TECHNOLOGY,
Florida Atlantic Univ., Boca Raton. Dept. of Geography.

Robert J. Tata, Cecil E. Plamer, and Richard E. Witmer.
Available from the Clearinghouse as AD-700 176, for $3.00 in paper copy, $0.65 in microfiche. U.S. Army Engineer Topographic Research Laboratory. Final Technical report (Appendix C), Ft. Belvoir, Va. Oct. 69, 97 p., 3 Bibliographies. Contract DAAK02-68-C-0219.

Descriptors: *Geographical regions, Mapping, *Remote sensing, Photogrammetry, Terrain analysis, Telemetry, *Wafer resources development, Analytical techniques.
Identifiers: *Geography.

In doing work for a research project on new geographic methods and techniques, the three reports and bibliographies included in this study were developed. Because the reports are of interest, but not directly related, to the central goal of the methodological treatise, they are presented for researchers concerned. The first report summarizes the results of a questionnaire survey of geographers who are active in researching methodological topics; the second report deals with the geographer's role in studies of water resource planning and management; and the final study comprises report and bibliography on new systems of remote sensing techniques.
W70-06466

UPPER MISSISSIPPI RIVERWAY COMPACT (NEW).

Iowa Code Ann secs 27A.1-27A.6 (Supp 1970)

Descriptors: *Iowa, *Interstate compacts, *Mississippi River, *Interstate commissions, Interstate rivers, Conservation, Recreation, Economics, Taxes, State governments, Water resources development, Aesthetics, Parks, Scenery, Social aspects, Agriculture, Industries, Land use, Local government, Administration, Administrative agencies, Legislation, Regulation, Supervisory control (Power), Projects, Financing.

The Upper Mississippi Riverway Compact is dedicated to the purpose of a sound and attractive Upper Mississippi Region which blends aesthetics with agricultural, economic and industrial progress. The Region's territorial boundaries are outlined. The Upper Mississippi Riverway Commission is created and certain powers and duties are imposed, relating specifically to improving environmental conditons of the Region. The Commission is not subject to state taxation. Financing for the Commission's work is provided. Land and water use and their preservation shall be the subject of special consideration by the Commission. Advisory committees may be established to aid the Commission. Procedural provisions for enactment of the Compact and its effect are outlined. The membership and composition of the Commission is described. The provisions of this Compact shall in no way conflict with the function of local government. (Barnett-Florida)
W70-06485

THE GREAT LAKES WATER RESOURCE,
Federal Water Pollution Control Administration, Chicago, Ill. Great Lakes Region.
H. W. Poston, and C. R. Ownbey.
Journal American Water Works Association, Vol 60, No 1, p 15-20, 1968. 4 ref.

Descriptors: *Great Lakes, *Water resources, Water quality, Eutrophication, Lake Erie, Lake Ontario, Lake Michigan, Phosphates, Productivity, Fertilization, Chemicals, Dissolved oxygen, Stratification, Bacteria, Sewage effluents, Storm runoff, Sewers, St. Lawrence River, Lake Huron, New York, Michigan, Illinois, Wisconsin, Ohio, Indiana, Pennsylvania.
Identifiers: Canadian government, Ontario, Detroit (Mich), Calumet River (Ill), Fox River (Wis), Saginaw River (Mich), Cuyahoga River (Ohio), Maumee River (Ohio), Menominee River (Wis).

Lake Erie has the largest contributing population to degradation on its watershed and the largest discharger of municipal effluents undergoing only token nutrient reduction. Modification of treatment plant design and operating practices can reduce phosphate concentration in waste water to a high degree. Accurate measurement of productivity and efficient techniques for control of aquatic organisms are needed. Chemical constituents are increasing; for example, chlorides tripled from 1910 to 1960; oxygen depletion results from overstimulation of biological activity; health hazards along the shores prevail from inadequately disinfected sewage effluents. The largest single planning effort under way at present is the Great Lakes-Illinois River Basins study under the Federal Water Pollution Control Act. The international Joint Commission is also coordinating a study. Plans for local actions are formulated. The administrators' and policy makers' task will be to assure proper balance in the efforts directed to research, plans for action and application. Some acceptable institutional arrangement must be evolved to settle disputes between conflicting interests. An organization having authority to command effective action must be established, correlating efforts of physical scientists, engineers, economists, lawyers, and political scientists. A TVA of the Great Lakes is suggested. (Jones-Wisconsin)
W70-06658

ECONOMIC EVALUATION OF WATER QUALITY: A MULTICOMPONENT MODEL OF OPTIMAL QUALITY CONTROL IN ESTUARINE WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06684

LINEAR OPTIMAL CONTROL THEORY AND THE CONTINUOUS DISPERSION MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06685

MATHEMATICAL PROGRAMMING FORMULATION OF THE DISPERSION MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06686

FRANKLIN COUNTY COMPREHENSIVE PLAN.
Franklin County Planning Commission, Columbus, Ohio.

Available from the Clearinghouse as PB-189 024, $3.00 in paper copy, $0.65 in microfiche. Comprehensive Regional Plan of Columbus and Franklin Counties, Ohio. December, 1969. 141 p.

Descriptors: *Long-term planning, City planning, *Water resources development, Land use, Sewage, *Municipal wastes, Community development.
Identifiers: Franklin County (Ohio), Open space planning.

The report contains the comprehensive regional plan for Franklin County, Ohio and some adjacent areas. It documents development of the land use plan and summarizes four separate published reports on plan elements. Three generalized 1985 regional land use concepts are evaluated. Recommended standards and objectives for industrial, residential and commercial uses are stated together with a discussion of the legal and organizational problems associated with plan implementation.
W70-06710

REFUSE DISPOSAL IN DUTCHESS COUN NEW YORK.
New York State Office of Planning Coordina Albany.
For primary bibliographic entry see Field 05E.
W70-06711

6C. Cost Allocation, Cost Sharin Pricing/Repayment

ECONOMIC ASPECTS OF HYDRO POWER,
Water Power Inc., London (England).
J. V. Hunter.
Water Power Vol 21, No 10, p 372, and 398, tober 1969.

Descriptors: *Interest rate, *Economic evalua *Hydro power, Planning, Inflation, Thermal po Loans financing, Costs, Economic efficie Capital costs, Cost-benefit analysis, Inco Operating costs, Cost minimization.
Identifiers: *Rate of return, Present value, Op tunity costs.

There is some confusion with regard to the effe monetary inflation on hydroelectric developm The relative merits of hydro and thermal po should be assessed to ensure that the pro chosen represents the best employment of avail resources, labor, materials, and finance in orde achieve the objective at minimum cost. The u method is to determine the present worth of two cash streams involving costs and revenue. author is concerned with the choice of an propriate discount rate. Due to the long life low operating costs of a hydro project this is im tant. The discount rate that is used sh represent the opportunity cost of capital. It sh also take into account the monetary inflation will occur over the life of the project. The pr discounting procedure will mitigate many of difficulties involved with planning for long per of time. (Murphy-Rutgers)
W70-06407

A RISK-RETURN ANALYSIS OF A FIR WORKING-CAPITAL POSITION,
Stanford Univ., Calif.
J. C. Van Horne.
Engineering Economist, Vol 14, No 2, p 71 Winter 1969. 19 p, 4 tab, 9 ref.

Descriptors: *Risks, *Capital, *Probability, *D *Financing, Management, Costs, Decision mak Budgeting, Labor, Taxes, Economics, Statis Credit.
Identifiers: *Working-capital, *Debt structure, portunity costs, Liquid assets, Cash flow, T horizon, Assets, Liabilities.

This article presents a method for manageme analysis of the risk-return tradeoff for various le of liquid assets for a firm and the different matu compositions of its debt. These factors deter the firm's working capital position. The techn involved utilizes various probability concepts assigned risks, as well as the opportunity cost the maneuvers involved. The purpose of technique proposed is to make possible more tional working-capital decisions, thus enabling firm involved to achieve a working-capital posi with a sensible ratio between safety of that posi and the costs in reaching it. This article is of terest to researchers in water resources sinc discusses the important management costs risks that are encountered in the workings of fi cial investment decisions. (Murphy-Rutgers)
W70-06409

APPLICATION OF LINEAR PROGRAMM TO SHORT-TERM FINANCING DECISION,
British Columbia Univ., Vancouver.
J. C. T. Mao.
Engineering Economist, Vol 13, No 4, p 221-2 Summer 1968. 21 p, 2 fig, 5 tab, 5 ref.

scriptors: *Decision making, *Capital costs, inear programming, *Financing, *Economic luation, Rate of interest, Computers, Costs, dgeting, Optimization, Uncertainty, Value, nagement, Taxes.
ntifiers: *Objective function, *Simplex al-ithm, Marginal analysis, Commercial paper, In-llment financing, Line of credit.

linear programming model is applied to a finan-l decision case study of a seasonal industry. Im-ted values and marginal analysis are used in this mple, which is designed to demonstrate the ucture and working of the model. The essential estion being asked is how best to finance sonal cash needs so as to minimize the cost of ancing. The cash budget of an agency reveals an-ipated cash drains. Three short-term financing ernatives exist; the problem is which will cost the st. Constraints on each alternative, and on the sh budget, are programmed and minimization of nd requirements is sought as the objective func-n. The program yields an optimal solution and cludes imputed values and marginal analysis. The ly stipulation in this method is the certainty of e cash budget. Since water resource projects are ally concerned with allocated cash budgets and ter supplying agencies do have seasonally condi-ned changes, managers of these projects will find is model useful. (Murphy-Rutgers)
70-06415

EVY DISTRICTS (TAXATION).

o Ann Stat secs 245.175 thru 245.220 (1959).

escriptors: *Missouri, *Levees, *Administrative encies, *Taxes, Land reclamation, Land, Land nure, Right-of-way, Surveys, Benefits, Damages, ssessments, Legislation, Construction, Costs, aintenance, Compensation, Land appraisal, egal aspects, Appraisals, Value, Government nance, Operating costs, Payment, Tax rate.
entifiers: *Levee districts.

he board of supervisors of any levee district shall vy a uniform tax to pay all expenses incurred in e organization of such district. Maximum assess-ents are provided. Where districts are extended, ew lands shall be subject to this tax. If the district ssolves, surplus money shall be refunded to lan-owners. Boards shall levy a total tax for costs of nprovements in proportion to the benefits accru-g to each landowner. Such total tax shall be paid rough the levy of an annual installment tax. rocedures to be followed in the collection of the ax are outlined. Boards may levy additional taxes here additional improvements are required and ay levy a mintenance tax to preserve improve-ents, but lands not protected by such improve-ents are not subject to this tax. Procedures are rovided for readjustment of tax assessments where alues in property change. Procedures are also out-ned for the collection of delinquent taxes and civil enalties provided for deliquency. Tax levies shall onstitute liens upon the land taxed. (Duss-lorida)
V70-06426

FFECTS OF METERING URBAN WATER,
olorado Univ., Boulder. Water Resources Pro-ram.
teve H. Hanke, and J. Ernest Flack.
ournal American Water Works Association, Vol 0, No 12, p 1359-1366, Dec 1968. 8 p, 2 tab, 4 ef.

Descriptors: *Water rates, *Water demand, Equipment, Water supply, Municipal water.
dentifiers: *Flat rates.

Under a flat rate system, consumers use as much water as they desire without incurring additional osts. Therefore, waste will occur since satisfaction vill be optimized when the last unit of water con-umed yields incremental benefits are close to zero. The metering of water represents an increase in the ncremental money price from zero to some posi-tive level, so that greater efficiency in the use of water supplies will result. Price-demand relation-ship may predict the effect of a price increase on total revenue through use of price elasticity of de-mand. Also, price is important as a control mechanism for the water supplier. Several studies are examined as to the effect of flat rates and water metering on the demand for water. The supplier can evaluate his alternatives (metering alone, in-creasing supplies, and a combination of both) in view of the effect of price increase on total revenues and water usage. (Grossman-Rutgers)
W70-06449

EVALUATION OF EFFICIENCY IN ALLOCATING CONTRACT RESEARCH FUNDS BY THE COLORADO WATER CONSERVATION BOARD,
Colorado State Univ., Fort Collins. Dept. of Economics.
David R. Allardice, and Kenneth C. Nobe.
Available from the Clearinghouse as PB-191 718, $3.00 in paper copy, $0.65 in microfiche. Colo State U, Economics Dept, Report No NRE-1, Dec 1968. 74 p, 6 fig, 17 tab, 1 append. OWRR Project A.005 - Colo (10).

Descriptors: *Grants, *Expenditures, Induced benefits, Contracts, Irrigation, Supply, *Cost benefit analysis.
Identifiers: *Colorado Water Conservation Board.

The major problems of managing and developing Colorado's water resources stem from unequal geographic distribution of supplies and users. The primary demand for water in Colorado has been for irrigation. The evaluation of research contracts includes an overall analysis of the Colorado Water Conservation Board's expenditures, a review of the individual contracts, an analysis of the contract procedure and an attempt to specify the nature of public benefits derived from these contracts. The history of the Board is also included. (Grossman-Rutgers)
W70-06452

EXPERIENCE WITH A WAGE INCENTIVE BONUS SCHEME AT GOSCOTE AND BROCKHURST SEWAGE WORKS,
B. R. Edmondson.
Water Pollution Control, Vol 68, No 4, p 437-442, July-Aug 1969. 1 fig, 2 tab, 2 ref.

Descriptors: *Waste water treatment, *Sewage treatment, *Working conditions, *Salaries, *Operation and Maintenance, Annual costs, Personnel, Performance, Income, Incremental income.
Identifiers: Time-work study, Bonus, Incentives, Performance.

A time-work study covering all the routine operations of two sewage treatment works was carried out. Based on an adjusted observed time of performance, each job was given a 'basic time' required for job completion. The total time allowed included rest allowances, special allowances, and seasonal allowances. A performance factor was devised relating allowed time to actual time. For every performance point over 100, the worker is paid a bonus as an incentive to better work. Difficulties arose in that if the work quality fell off, the bonuses were not paid, and the men could not understand why their paychecks decreased. Job values must be maintained at a fair rate to both management and labor. Labor unions recommended that all local authorities introduce incentive bonus schemes based on genuine work measurement techniques and having regard to the code of guiding principles, which recommends a bonus of 33 1/3% of basic pay rate for a standard performance. (Makela-Texas)
W70-06595

6D. Water Demand

WATER SUPPLY ECONOMICS IN THE POTOMAC RIVER BASIN,
Resources for the Future, Inc., Washington, D.C.
Robert K. Davis.
American Water Works Association Journal, Vol 56, No 3, p 257-266, March 1964. 10 p, 2 fig, 11 ref.

Descriptors: *Water quality, *Planning, *Water supply, *Economic efficiency, *Costs, Recreation, Benefits, Dissolved oxygen, Pollution, Water storage, Flow control, Capital, Operating costs, Waste treatment.
Identifiers: *Potomac River Basin, *Corps of Engineers, *Capital intensive system, *Operating cost system.

Planners must devise the best combination of quantity and quality control measures in view of growing and conflicting demands. Although withdrawal use of water will increase by large amounts in the next fifty years it is the greatly increasing waste load which poses the greatest problem. In the Potomac estuary the author gives two kinds of solution to pollution problems: increase waste assimilation capacity or reduce the amount of waste discharged. The costs involved in each method are studied for the purpose of applying cost-benefit analysis to the problem. The author discusses the economic problem of determining whether there is some combination of fixed and varying system capacity which is more efficient than either a system with a virtually fixed capacity or one with an almost completely varying capacity. Thus, the present value of such an investment, the distribution of low flows, the efficiency of each and the quality objectives are discussed and evaluated in this article. (Murphy-Rutgers)
W70-06437

AUSTRALIAN AND AMERICAN WATER ALLOCATION SYSTEMS COMPARED,
Peter N. Davis.
Boston College Industrial and Commercial Law Review, Vol 9, No 3, p 647-710, Spring 1968. 57 p, 343 ref.

Descriptors: *Foreign countries, *Water demand, *Water allocation (Policy), *Preferences (Water rights), Water law, Surface waters, Riparian rights, Mill dams, Reasonable use, Riparian land, Competing uses, Domestic water, Relative rights, Prescriptive rights, Eminent domain, Groundwater, Public rights, Navigation, Legal aspects, Legislation, Prior appropriation, Geographical regions, Priorities, Beneficial use, Permits.
Identifiers: *Australia.

Four water-use doctrines are examined: riparianism, prior appropriation, temporal non-priority permit systems, and market place concepts. The strengths and weaknesses of each are compared in light of 5 criteria: (1) security of the water right for investment purposes; (2) efficiency of water use; (3) flexibility in the allocative process to allow for economic growth, changing technology and changing demands; (4) protection of the public interest and preservation of watercourse amenities; and (5) the allowance of scope for private initiative. The Australian system for licensing private diversions is examined as an example of a temporal non-priority permit system. An analysis of alternative doctrines for water allocation in the United States is made with a view to selecting the one most suitable for allocating water in the eastern United States. (Cuevas-Florida)
W70-06467

OPTIMAL DISTRIBUTION OF WATER RESOURCES BETWEEN WATER USERS AND WATER CONSUMERS,
M. P. Fel'dman, A. L. Velikanov, and A. G. Kudinov.

Trans from Gidroteknicheskoe Stroitel'stvo, No 4, April 1969, p 25-28. Hydrotech Constr, No 4, ASCE, p 330-334, April 1960. 5 p, 6 ref.

Descriptors: *Optimization, *Water distribution (Applied), *Planning, *Multiple-purpose projects, *Dynamic programming, Water resources development, Water shortage, Mathematical models, Physicial properties, Resource allocation, Water users.
Identifiers: Consumers.

The problem of optimal utilization of water resources in the Soviet Union was discussed. The objective of the study was to formulate a technique for planning multipurpose water projects. The solution to this problem was preceded by an examination of (a) criteria of general effectiveness, (b) systems of initial information, including the economic and physical characteristics of water resources and the activity of the individual consumer under normal conditions of water shortage, and (c) selection of the mathematical model and algorithm for its solution. Dynamic programming was recommended for the distribution of given resources to specified components at a calculated level. (Thiuri-Cornell)
W70-06689

6E. Water Law and Institutions

SUMMARY OF WATER QUALITY STANDARDS FOR THE INLAND AND COASTAL WATERS OF TEXAS.
Federal Water Pollution Control Administration, Austin, Tex., and Texas Water Quality Board, Austin.
For primary bibliographic entry see Field 05G.
W70-06357

UNITED STATES V 222.0 ACRES OF LAND (PROPOSED BRIDGE CONSTRUCTION).

306 F Supp 138-156 (D Md 1969).

Descriptors: *Maryland, *Bridge construction, *Abutments, *Accretion (Legal aspects), Judicial decisions, Boundaries (Property), Navigable waters, Road construction, Access routes, Land reclamation, Land development, Federal government, State governments, Legislation, Regulation, Riparian rights, Riparian water, Land tenure, Bridges, Condemnation.
Identifiers: *Causeways.

A realty company and a bridge corporation entered into a complex transaction of land deeds involving reverter provisions for noncompliance with stipulated conditions. The land was given to the bridge corporation on condition that it would get the necessary permission, procure sufficient financing and attempt to build a bridge which would connect the mainland to an island on which the realty company owned other lands. The lands would thus be enhanced in value. The corporation procured partial financing for the bridge with the realty company's assistance. Lots on filled land which the realty company knew were encumbered by reverter provisions but which they did not relate to the purchasers were sold to raise funds. The bridge was not completed. The United States district court in Maryland, in a condemnation proceeding brought by the United States, found the realty company estopped to claim ownership in those lots sold with their assistance and with knowledge of the reverter provisions. Alluvion, accretion, and reliction in navigable waters are defined, and the effect of riparian ownership on lands so created is examined in light of Maryland Law. The court concluded that the bridge company's filled land was an integral part of the proposed bridge and was considered an 'improvement' within the meaning of a Maryland statute vesting ownership in the bridge company. (Barnett-Florida)
W70-06419

LEGAL LIABILITY AND LIMITATIONS WHEN PRIVATE PROPERTY IN COLORADO IS USED FOR OUTDOOR RECREATION,
Colorado State Univ., Fort Collins. Dept. of Economics.
George E. Radosevich, and Kenneth C. Nobe.
Available from the Clearinghouse as PB-191 717, $3.00 in paper copy, $0.65 in microfiche. Colorado State University, Dept. of Economics, Report No NRE-3, April 1969. 43 p, 3 append, 111 ref. OWRR Project A.005-Colo (9).

Descriptors: *Legal aspects, *Recreation, Recreation facilities.
Identifiers: Private property, Colorado Landowner Liability Act.

Colorado law, court cases, and regulations that deal with farmers, ranchers, and recreationists, are summarized. The following legal aspects are covered: Categories of real property and rights; Right of the possessor or property to exclude persons from the premises; Liability of owners and possessors of land for injuries and damage to other properties; User's liability for injuries and damages caused by the user, including easement owners having rights in the land; Owner or possessor's vicarious liability; Bailor liability; Product liability of seller; Liability of the state to land owners for activities of wild animals; and, Methods of limiting liability. (Grossman-Rutgers)
W70-06451

AUSTRALIAN AND AMERICAN WATER ALLOCATION SYSTEMS COMPARED,
For primary bibliographic entry see Field 06D.
W70-06467

SOVEREIGNTY SUBMERGED AND TIDAL LANDS IN COASTAL AND INTRACOASTAL WATERS.

Fla Admin Code, ch 200-2, 1968.

Descriptors: *Florida, *Water rights, *Dredging, *Ownership of beds, Bulkheads, Bulkhead line, Permits, State jurisdiction, Water resources development, Legislation, State governments, Accretion (Legal aspects), Boundaries (Property), Bank erosion, Avulsion, Docks, Piers, Jetties, Coastal structures, Retaining walls, Navigation, Conservation, Ecology, Environmental effects, Riparian rights, Navigable waters, Administrative agencies, Regulation.

Sovereignty , submerged and title lands shall include islands, sandbars, shallow banks, spoil islands and such areas of the bottom lands of meandered fresh water connected with or flowing into coastal and intracoastal navigable waters as are subject to ebb and flow of daily normal tides. In establishing bulkhead lines Trustees of the Internal Improvement Fund and local political subdivisions shall consider aspects of navigation, transportation, recreation, conservation, erosion control and problems of the immediate area. No dredging and filling of sovereignty lands may be undertaken without a permit issued by the local governing body and approved by the Trustees. Dredging of sovereignty lands to fill submerged lands must be limited to areas riparian to or directly seaward from the area to be filled. Any dredging project in the sovereignty waters is required to have a permit from the state. Dredging to improve navigation must not exceed requirements of normal boating. Biological survey reports may be required before any permit is issued. Rights-of-way may be granted in recognition of the servitude in favor of commerce and navigation. Permits are required for piers, wharves and docking facilities. The requirements for the approval of these projects are set forth. (Hubener-Florida)
W70-06470

PROBLEMS OF FEDERAL AND STATE RELATIONSHIPS IN THE FIELD OF WATER LAW,
Stanley Mosk.
ABA Sec of Mineral and Natural Resources (1962 Proceedings), p 120-124, 1962. 5 p.

Descriptors: *Federal-state water rights conf *Water rights, *Prior appropriation, *Stat risdiction, Water law, Federal government, governments, Legislation, Judicial decis Federal jurisdiction, Political aspects, U States, Legal aspects, Public lands, Appropria Preferences (Water rights), Riparian rights, tive rights, Watersheds (Basins), Federal P Act, Jurisdiction.

In case and statutory law, the federal govern has protected the doctrine of prior appropriati the West. The only inhibitions have been wher United States itself asserts a water right, and t have been generally in accordance with state However, a 1955 decision allowed the Fe Power Commission to build a dam across a navigable river on federal lands not a part o public domain. This raised a fear that the fe government could claim ownership of all u propriated waters in the West, since watersheds are national forests. Federal legisl has not been able to relieve this apprehen Congress has not been able to deal with we water law because it has not been able to esta which rights have vested under state laws. Fe law must defer to state law. Complex prob require specialized, practical, local solutions. federal government too often sticks to princ that make no sense at all because the individua volved do not have the practical knowledge local problems demand. (Douberley-Florida)
W70-06471

FISH AND GAME REFUGES.
Conn Gen Stat Ann secs 26-99 thru 26-107 (19 as amended, (Supp 1969).

Descriptors: *Connecticut, *Fish managem *Fish conservation, *Wildlife conserva Legislation, Administration, Administrative a cies, Boundaries (Property), State governm Aquatic environment, Fish hatcheries, Fish, La Legal aspects, Public rights, Regulation, Trapp Hunting, Rivers, Islands, Tidal waters, Water f Harbors.

The State Board of Fisheries may establish s fish and game refuges. The Board may lease land or lake or accept gifts of land or incom help propagate and preserve fish and game in state. Such lands may be posted war unauthorized persons not to enter. Wildlife ref on private and public land can be closed to hunt trapping, and fishing. The Board may establish spawning areas on any waters. It shall have er gency authority to declare a closed season on fish species if the species is threatened with un depletion. If such depletion is caused by any c mercial fishing activity, the Board may regu such activity and suspend such rights as they d necessary. No person shall hunt, trap, fish, destroy any wildlife or permit his dog to enter tain specified refuges. Penalities for violation this act are provided. (Barnett-Florida)
W70-06473

WATER AUTHORITIES (POWERS OF LOC WATER AUTHORITIES).
Ill Ann Stat ch 111 2/3, secs 223-250 (Smith-H 1966), as amended, (Supp 1970).

Descriptors: *Illinois, *Administrative agenc *Water resources development, *Water mana ment (Applied), Permits, Legislation, Regulati Public health, Water pollution, Water alloca (Policy), Water supply, Well regulations, Well p mits, Boating regulations, Fishing, Sewage, Do Water quality, Swimming, Recreation facili Reservoir operation, Easements, Financing.

Water authorities may be organized at the cou level upon petition of at least 500 voters. S authorities are empowered to: (1) inspect, regul

l register wells; (2) establish priorities and erwise regulate water use; (3) license and regue water craft; (4) approve construction of docks; establish recreational areas, parks, and access ds; (6) acquire an area for a reservoir and police h area; (7) grant easements; (8) sell or dispose real or personal property; (9) protect public lth; (10) operate a water distribution and age system; (11) abate pollution of water rces; (12) enforce ordinances and laws necessato its functions; and (13) regulate fishing, boat- and swimming. The authority may also issue nds to finance construction and acquisition of perty. Revenue derived from supplying water y be used to pay the interest on bonds and the t of operation of the waterworks. (Hubenerrida)
70-06475

ATER RESOURCES ACTIVITIES IN THE ITED STATES (POPULATION PROJECONS AND ECONOMIC ASSUMPTIONS).
lect Committee on National Water Resources .S. Senate), Washington, D.C.

nate Comm on National Water Resources, Popuion Projections and Economic Assumptions, S s 48, 86th Cong, 2d Sess (1960).

scriptors: *Population, *Water resources velopment, *Water requirements, *Future nning (Projected), Estimating, Economic effincy, Governments, Non-structural alterations, search and development, Water allocation (Pol-), Legislation, Federal government, Water sources planning, Analytical techniques, ethodology, Cities, Charts, Statistical methods, nsus, Data collections, Measurement, Statistics.

e select committee on National Water sources, charged with studying water requirements for the population, agriculture and industry the United States between 1960 and 1980, found necessary to develop projections of population d economic growth. Details as to the means, ethods and procedures of compiling this data and e results of such analysis are found herein. Part e is the staff report dealing with population prctions and economic assumptions. Part two consts of the report of the Census Bureau with its pulation projections. Part three consists of an alysis of the differences between the two sets of ojections and a discussion of alternative ways of aking projections for standard metropolitan areas the future. Future population projections for the nited States range from 225 to 278 million in 80, and from 267 to 431 million in the year 00. The gross national product in 1960 was aproximately $500 billion. This should reach tween $960 and $1,260 billion in 1980. Numerous graphs, charts and tables are included. Barnett-Florida)
70-06476

EGAL ASPECTS OF LAKE DIVERSION IVERSION FROM LAKE MICHIGAN, AND ISPOSAL OF SEWAGE INTO THE MISSISSIP- WATERSHED, BY CHICAGO),
ntony A. Olis, and Robert A. Sprecher.
orthwestern University Law Review, Vol 51, No p 653-674, Feb 1957, 22 p, 110 ref.

escriptors: *Diversion, *Lake Michigan, *Sewage sposal, *Watersheds (Basins), Legal aspects, akes, Municipal wastes, Canals, Water utilization, ithdrawal, Federal government, Judicial decions, Navigation, Drawdown, Water allocation Policy), Low-flow augmentation, Institutional nstraints, Treaties, Legislation, Consumptive e, Cities, Jurisdiction, Transportation, Water pply, Mississippi River Basin.

ecause of its need for a large supply of uncon- minated water, Chicago takes its water from ake Michigan and by an extensive canal system sposes of its wastes into the Mississippi atershed. This practice has aroused protests of water level drawdown and increased wastes from both the Great Lakes states and Canada. Efforts to increase the amounts of diversion of water from Lake Michigan have met with much opposition, and have led to extensive litigation since the early 1900's. The canal system between Chicago and the Mississippi serves both for sewage disposal and as a means for water transportation between the Great Lakes and the Mississippi Basin and the Gulf. The need for improved transportation is probably a more convincing argument for increased diversion from the lake than sewage disposal needs. Even though the United States Supreme Court has retained jurisdiction over the issue, Congress' dominion over navigable inland waterways gives it the power to regulate the diversion of lake water by statute. Treaty obligations with Canada do not prevent an increase in lake diversion, it is argued, and such increase is likely. (Caldwell-Florida)
W70-06477

A COMPARISON OF OIL AND GAS LEASING AUTHORITIES IN THE GULF OF MEXICO (STATES OF ALABAMA, MISSISSIPPI AND LOUISIANA AND THE FEDERAL GOVERNMENT) AND THE JURISDICTIONAL CONFLICT OVER THE BOUNDARY BETWEEN STATE AND FEDERAL AUTHORITY IN THE GULF OF MEXICO,
Jean R. Richey.
Mississippi Law Journal, Vol 40, No 3, p 351-392, May 1969. 42 p, 156 ref.

Descriptors: *Submerged Lands Act, *Gulf of Mexico, *Boundary disputes, *Leases, Mississippi, Alabama, Louisiana, Legislation, Planning, Administration, Administrative agencies, Contracts, Riparian rights, Littoral, Tidal waters, Continental shelf, Boundaries (Property), High water mark, Low water mark, Shores, Legal aspects, Judicial decisions, Equitable apportionment, Negotiations, Water rights, Oil industry, Natural gas, Exploitation, Oil fields, Exploration, Federal government.

The leasing of lands in the Gulf of Mexico for oil, gas, and mineral exploration is controlled by the federal government and agencies of the states of Alabama, Mississippi and Louisiana. The legislative basis for the jurisdiction to lease such lands is found in the 'Submerged Lands Act' and the 'Outer Continental Shelf Lands Act.' The provisions of these acts are examined. The composition and function of the states' regulatory agencies is contrasted with the powers of the federal government under the enabling legislation. The procedures, regulations, powers and functions of each state agency are examined as well as each state's statutory enactments relating to such leasing. Because of uncertainty as to the exact location of the boundary line between federal and state areas under the Submerged Land Act, conflicts have arisen between state and federal leasing authorities. The states' arguments are presented, and examples of litigation between the federal and state agencies are discussed. Suggested means of resolving the conflict are presented, one of which is recourse to Congress for clarifying legislation to establish a division of authority between state and federal agencies. (Barnett-Florida)
W70-06478

A REPLY TO MR. FINLAY (EXCLUSIVE MINERAL RIGHTS IN THE CONTINENTAL SHELF),
Louis Henkin.
American Journal of International Law, Vol 64, No 1, p 62-72, Jan 1970. 11 p, 19 ref.

Descriptors: *Ownership of beds, *Continental shelf, *Marine geology, *Structural geology, Beds under water, Beds, Regions, continental margin, Oceans, Coasts, Mineralogy, Legal aspects, International law, Oil industry, International waters, Jurisdiction, Judicial decisions.

The National Petroleum Council and Mr. Finlay, a petroleum industry spokesman, take the position that the continental shelf includes those seabeds which are potentially exploitable; therefore, the coastal states can claim exclusive mineral rights in such areas. This contention is neither supported by the Articles of the Convention of the Continental Shelf nor by legislative history. The coastal state cannot claim adjacent seabed in the continental shelf until it becomes actually exploitable. Mr. Finlay also contends that the legal shelf for exclusive mineral rights includes the entire submerged continental mass down to the deep ocean basin. The correct interpretation is that only so much of the submerged land mass adjacent, near, or within some maximum distance from the coast can be claimed as continental shelf. Mr. Finlay relied on the legislative history of the Convention, the Cuidad Trujillo Resolution and the North Sea Cases to support the view that 'adjacent' means all the submerged land mass regardless of proximity to the coast. Deliberations of the International Law Commission which drafted the Convention's Articles do no support Mr. Finlay. In fact, the Commission's final report adopted, to a certain extent, the geographical test for the continental shelf. Furthermore, the Trujillo Resolution was not incorporated into the Convention's articles, and the International Court of Justice cases do not support the contentions of the Council and Mr. Finlay. (Powell-Florida)
W70-06479

THE UNITED NATIONS AND THE BED OF THE SEA,
Clark M. Eichelberger.
San Diego Law Review, Vol 6, No 3, p 339-353, July 1969. 15 p, 19 ref.

Descriptors: *International waters, *Continental shelf, *Exploitation, *Ownership of beds, United Nations, International law, International commissions, Legal aspects, Exploration, Oceanography, Resource development, Sea water, Natural resources, Conservation, Water pollution, Technology, Mineralogy, Economics, Economic impact, Military aspects, Treaties, Navigation, Regulation, Coasts, Drilling, Oil, Beds under water, Water pollution control.

The seabeds should be reserved from national claims of sovereignty and their use limited to peaceful purposes. All nations should have access to seabeds for exploration and exploitation. An authority of the United Nations should be created to control such access. Economically, seabeds are of great importance, and advancing technology requires the establishment of an international regime. Today there are many difficulties concerning jurisdiction over the ocean floor. Much of the trouble is derived from ambiguous wording in the 1958 Convention on the Continental Shelf. The Convention has left open the possibility of nations claiming exclusive sovereignty over seabeds beyond points where water depth exceeds 200 meters. The United Nations General Assembly has responded to these problems in several ways including: (1) creation of a committee to study legal aspects which would promote international cooperation and control; (2) studies for marine pollution control; and (3) efforts to formulate an international control authority. Unfortunately, there have been many areas of disagreement among the nations. These include: (1) the area of the seabeds to be controlled; (2) the meaning of restrictions to peaceful purposes; and (3) the form of the legal authority to govern seabeds. The Commission to Study the Organization of Peace has submitted a set of principles that should be adopted regarding access to and development of seabeds. These should be adopted as a step toward creation of an effective international regime. (Duss-Florida)
W70-06480

THE CONTINENTAL SHELF AND THE UNITED STATES,
J. Munford Scott, Jr.
South Carolina Law Review, Vol 22, No 1, p 34-49, 1970. 15 p, 43 ref.

Descriptors: *Continental shelf, *United States, *International law, *Law of the sea, Oceans, International waters, Treaties, Legal aspects, Sea water, International commissions, Navigation, Littoral, Judicial decisions, Continental slope, Legislation, Submerged Lands Act, Federal government, Continental margin, Structures, Jurisdiction, Political aspects, Islands, Construction, Public rights, Relative rights.

Control of the continental shelf has been a historic concern of nations, culminating in many divergent attempts by nations in the last 30 years to establish jurisdiction over contiguous continental margins. Two theories of ocean floor ownership exist: (1) res communis--that it belongs to all nations equally and cannot be controlled exclusively by any one state, and (2) res nullius--that it belongs to no state and is capable of acquisition by effective control. The Geneva Convention on the Continental Shelf was drafted to apply international law to these divergent viewpoints, and provided that a nation could claim the shelf to a depth of 200 meters. The Convention further provided that this control was in the nature of a sovereign right for the purpose of exploration and exploitation, thus leaving undisturbed traditional rights of navigation in the above waters. The United States has passed several laws concerning the continental shelf, including the Submerged Lands Act, which assert national jurisdiction over the shelf and provide for the exploitation of its resources. It was not specifically provided, however, that jurisdiction extends to artificial structures not for exploration or exploitation which were on the shelf but outside the three mile limit. A recent case illustrated this; it involved an attempt by private developers to build an island which in effect would have been a new sovereign nation, on the shelf. The island was held to constitute an obstruction to navigation and subject to prohibition by federal law. (Caldwell-Florida)
W70-06481

RECENT DEVELOPMENTS CONCERNING THE EXPLORATION AND EXPLOITATION OF THE OCEAN FLOOR,
Allan E. Gotlieb.
McGill Law Journal, Vol 15, No 2, p 260-278, June 1969. 19 p, 28 ref.

Descriptors: *Oceans, *Continental shelf, *Conservation, *Law of the sea, Marine fisheries, Sea water, Natural resources, Legal aspects, Marine geology, International law, Public rights, Federal government, Legislation, Negotiations, Project planning, Regulation, Water rights, Water resources development, Administration, Administrative agencies, Navigation, Fishing, Mineralogy, Continental slope, Exploration, Exploitation, International waters, State governments, State jurisdiction.

The seas and their natural resources are of immense value to man. A basic lack of interest in this resource has been replaced by a deep concern for the conservation, exploration and exploitation of the ocean floor. This interest has been spurred by the realization that the rapidly diminishing resources are not inexhaustible and that national and international efforts in the fields of research, management and conservation are necessary. The basic question approached herein is: What is the present status of international law with regard to the rights of states to exploit the resources of the sea-bed. Article 1 of the Convention on the Continental Shelf is examined in great detail, while superficial treatment is given to the balance of the Convention. Other related legal aspects to freedom on the high seas for travel and exploration are discussed. Theoretical legal possibilities, termed by the author alternative regimes, are proposed as a means of internationally controlling the exploitation and exploration of this vital natural resource. (See also W70-06483 thru W70-06484). (Barnett-Florida)
W70-06482

RECENT DEVELOPMENTS CONCERNING EXPLORATION AND EXPLOITATION OF THE OCEAN FLOOR (INTRODUCTION AND DISCUSSION OF THE PRESENT LAW),
Allan E. Gotlieb.
McGill Law Journal, Vol 15, No 2, p 260-270, June 1969. 11 p, 24 ref.

Descriptors: *Continental shelf, *Continental slope, *Oceans, *Marine geology, Structural geology, Administration, Legal aspects, Law of the sea, Internation law, Regulation, Federal government, Mineralogy, Ownership of beds, Beds under water.

In 1958, the Geneva Convention on the Continental Shelf had the most significant effect on settling the subject of international property rights of the ocean's floors. In Article 1 of the Convention, concern was limited to the continental shelf, that area which the Convention felt was significantly affected by international exploration and exploitation. The continental shelf is: (1) the seabed and its subsoil; (2) adjacent to the coast; (3) where the territorial sea ends; and (4) limited to a depth of 200 meters. These four main elements of the definition of the continental shelf are examined. It is suggested that this definition may create problems of interpretation in that it takes little account of the geographical-geophysical realities of the oceanic submerged areas. The other articles are examined to better grasp the underlying principles of the Convention. The question of sovereign rights is cited as extremely confused but vital. It is felt that the Convention is not fully satisfactory in that it was handicapped by a lack of technical information. However, it does embody essential rules which are extremely vital. (See W70-06482). (Barnett-Florida)
W70-06483

RECENT DEVELOPMENTS CONCERNING THE EXPLORATION AND EXPLOITATION OF THE OCEAN FLOOR (ALTERNATIVE LEGAL POSSIBILITIES),
Allan E. Gotlieb.
McGill Law Journal, Vol 15, No 2, p 270-279, June 1969. 9 p, 4 ref.

Descriptors: *Oceans, *Law of the sea, *International law, *Conservation, Regulation, Legal aspects, Governments, Foreign countries, Planning, Legislation, Political aspects, Natural resources, Water resources development, Jurisdiction, Federal jurisdiction, Ownership of beds, Beds under water, State jurisdiction.

The Convention on the Continental Shelf has caused an outcry for a new definition of the limits of national jurisdiction on the ocean floor. Some alternatives to achieve this end are discussed and discarded by the author. The alternatives discarded are: (1) a division of the seabed and ocean floor by agreement amongst all nations; (2) coastal states extending their jurisdiction as far as technology permits up to the median line in accord with the Convention; (3) declaring beds beyond defined limits of seabed as res nullium and susceptible of occupation; (4) control analogous to that used in the exploration of outer space; and (5) some form of international control. All of these alternatives are deemed unfeasible. The only method of adequate control is the establishment of a new legal system, with new legal rules which would establish that the resources of the deep ocean floor can be developed and used for the benefit of mankind as a whole. The current position of the law and future prospects are examined in light of projected needs. (See W70-06482). (Barnett-Florida)
W70-06484

LEVEE DISTRICTS (BOARD OF SUPERVISORS AND BOARD OF COMMISSIONERS).
Mo Ann Stat secs 245.095 thru 245.135 (1959).

Descriptors: *Missouri, *Administrative agencies, *Water management (Applied), *Land reclamation, Rivers, Streams, Channels, Levees, Flow, Overflow, Drainage engineering, Ditches, Se
Pumping plants, Embankments, Dikes, Sl
Right-of-way, Condemnation, Easements, Ber
Damages, Planning, Legislation, Judicial deci
Diversion.
Identifiers: *Levee districts.

In order to effect the leveeing, protection,
reclamation of land and other property in leve
tricts, the Board of Supervisors has authori
construct necessary improvements upon levee
waters within such districts. This includes the
struction of such improvements as dikes, c
ditches, and pumping stations. The power o
Board extends to condemnation of land. The B
shall appoint a chief engineer and approve nec
ry assistants to direct the engineering work i
district. The chief engineer shall submit a pl
the Board for the leveeing, reclaiming, or pr
tion of district lands. The Board shall pass upo
plan. The secretary of the Board shall file the
with the circuit court; and the Board shall pe
the court to appoint commissioners to apprais
lands to be acquired for rights-of-way. The B
of Commissioners appointed shall inspect
lands, assess the benefits and damages and the
a report with the court. Property owners
receive notice of the report and may file excep
to it. The circuit court shall rule on the report
court shall dissolve the district if projected co
improvements exceed benefits. (Duss-Florida)
W70-06487

THIRD CLASS CITIES (ACQUISITION SEWER ROUTES).

Mo Ann Stat secs 88.563 thru 88.590 (1952).

Descriptors: *Missouri, *Cities, *Se
*Drainage systems, Legislation, Legal asp
Conveyance structures, Sewage districts, Con
nity development, Watercourses (Legal), Dr
Public utilities, Condemnation, Construc
Maintenance, Right-of-way, Cost allocation, L
governments, Construction costs, Assessments

Whenever a third class city proposes to make u
any natural course of drainage or watercourse
public drain or sewer route or land for the erec
and maintenance of disposal plants, the acting
nicipal authorities, by ordinance, shall declare
same to be a public drain and sewer route. Th
dinance declares what sewer districts are bene
by the use of the natural watercourse as a pu
drain or sewer route. The use of any waterco
can be acquired by gift, purchase or condemna
Any part of the requisite right-of-way for any s
through private property is acquired by conder
tion. The cost of acquiring the use of a waterco
is collected by special tax from the terri
benefited by such acquisition. Provisions regu
the assessment of damages resulting from
acquisition or appropriation of the waterco
The appointment of commissioners to as
damages is regulated. The sewer acquisitions
appropriation costs, including the cost of acqu
land for the erection and maintenance of disp
plants, constitute a lien on all the lands within
district, exclusive of public highways, streets,
alleys. (Powell-Florida)
W70-06488

**MARLATT V PEORIA WATER WO
(SCOPE OF PUBLIC UTILITY'S EASEMENT**
252 NE2d 403-410 (3d Dist Ill 1969)

Descriptors: *Illinois, *Easements, *Public u
ties, *Usufructuary right, Judicial decisions, W
distribution (Applied), Facilities, Utilities, L
aspects, Local governments, Real property, La
Land use, Pipes, Pipelines, Conduits, Water sup

Plaintiff acquired property burdened by an e
ment for the use of public utilities to install
maintain gas pipes, conduits, cables, poles,
wires for the purpose of serving adjoining prop
with gas, electric, and telephone service. A w

n was constructed by defendant extending par-
y below the surface of plaintiff's lot. Water ser-
for plaintiff's house was not provided by use of
main beneath his lot. Plaintiff brought an action
respass and ejectment. THE LOWER COURT
LD FOR PLAINTIFF. Defendant appealed,
ing his argument on the reservation of an ease-
it for public utilities service. This court af-
ed, holding that easement created by reserva-
s in a deed is limited to the scope and purpose
he easement as specifically delineated on the
orded plat. The reservations in question made
mention of water pipes and the burden of the
ement on plaintiff could not be extended by im-
ation. If the reservation was in favor of public
ities generally such a right might be implied, but
additional specific language in the present ease-
nt precluded such interpretation. (Dye-Florida)
0-06489

SE V FRANKLIN (TITLE TO LAND UTTING ON NON-NAVIGABLE STREAM AS NNING TO MIDDLE OF STREAM).
E2d 876-877 (NC 1939).

scriptors: *North Carolina, *Boundaries (Pro-
ty), *Boundary disputes, *Non-navigable
ers, Riparian rights, Riparian land, Ownership
eds, Land tenure, Streambeds, Riparian water,
eams, Rivers, Meanders, Surveys, Judicial deci-
ns, Legal aspects, Mapping, Water law, Beds,
ds under water, Bench marks, Relative rights.

intiffs held a deed to riparian land which
cified that the boundary thereof ran to a certain
nt in the river and then 'down the meanders of
river.' Plaintiffs claimed that their title ex-
ded under this deed to the middle of the non-
igable river. Defendant claimed he had previ-
sly been granted the entire bed by the state. The
rt held that the description in the plaintiffs'
ed made the river the boundary and that specifi-
ly the boundary was the middle of the non-
igable stream. Since defendant had previously
mitted that plaintiffs had title to all lands within
boundaries described in the deed, the judgment
plaintiff in the ejectment action below was af-
med. (Caldwell-Florida)
70-06492

ELLY V KING (EXTENSION OF RIPARIAN AND BOUNDARY TO MIDDLE OF STREAM).
SE2d 220-225 (NC 1945).

scriptors: *North Carolina, *Non-navigable
ters, *Boundary disputes, *High water mark,
undaries (Property), Marshes, Ownership of
ds, Channels, Land tenure, Beds under water,
aps, Swamps, Surveys, Damages, Legal aspects,
dicial decisions, Riparian rights, Riparian land,
vigable streams, Beds, Water law, Legislation,
eclamation.

aintiffs owned land abutting on a sound, and their
eds either specified that the boundary was the
gh water mark of the sound or made reference to
recorded plat which showed the high water mark
boundary. The court found the sound, consisting
a marsh and a small channel, to be non-naviga-
e, and held that while generally the title to ripari-
land on non-navigable waters extends to the
ddle of the waterway, the specific words in the
eds and the plat superseded this rule. Although
e deeds of some plaintiffs specified boundaries
her thn the high water mark, the court ruled that
e plat was incorporated by reference into the
eds and was sufficient to overcome the conflict-
g descriptions in the deeds. (Caldwell-Florida)
70-06493

WELL V LAMBERT (THE TEST FOR AVIGABILITY OF A STREAM).
SE2d 333-336 (Va 1941).

escriptors: *Virginia, *Ownership of beds,
Riparian rights, *Non-navigable waters, Bounda-
ries (Property), Judicial decisions, Legal aspects, Boundary disputes, Streams, Navigable waters, Riparian waters, Riparian land, Beds, Tidal waters, Administrative agencies, Beds under water, Relative rights, State governments, Jurisdiction.
Identifiers: *Non-tidal waters, *Oyster planting grounds.

Plaintiffs were the separate owners of real estate situated on a creek. The portion of the creek adjacent to their lands had always been a non-tidal and non-navigable body of water. Plaintiffs and their predecessors in title had always asserted their ownership of the creek and its beds in fee simple. The defendants, an oyster inspector and the Virginia Commission of Fisheries, advised the plaintiffs that the Commission had jurisdiction over the bed of such creek and that defendants had received and were considering an application for the assignment of a portion of the creek bed adjacent to plaintiffs' land as oyster planting grounds. Plaintiffs sought an injunction restraining the defendants from asserting jurisdiction over the described portion of the creek bed and from assigning such portion of the submerged lands as oyster grounds. The defendants contended that the said creek was both tidal and navigable. The appellate court affirmed the chancellor's decree granting a permanent injunction against defendants. The court stated that the question of navigability was one of fact. The test of navigability is whether the stream is being used or is susceptible of being used, in its natural and ordinary condition, as a highway for commerce, on which trade and travel are or may be conducted in the customary modes of trade and travel on water. The court also recognized the rule that a grant or conveyance of land bounded by a non-navigable stream carries with it title to the bed of the stream to its center, unless there is contrary intent in the deed. (Powell-Florida)
W70-06494

MUELLER V KLINHART (RIGHT TO USE PORTION OF ARTIFICIAL LAKE OVERLYING ANOTHER'S PROPERTY).

167 SW2d 670-671 (Ct App Mo 1943).

Descriptors: *Missouri, *Boundaries (Property), *Artificial watercourses, *Barriers, Lakes, Ownership of beds, Non-navigable waters, Relative rights, Riparian rights, Reasonable use, Easements, Riparian land, Bodies of water, Judicial decisions, Legal aspects, Lake beds, Recreation, Non-consumptive use, Public rights, Water law, Usufructuary right, Remedies, Land tenure.

Plaintiffs sought to enjoin defendants from maintaining barriers along the boundary lines of defendants' portion of the bed of an artificial non-navigable lake. The effect of these barriers was to prevent plaintiffs and their guests from using the waters over the beds belonging to the defendant. The court held that where plaintiffs' property was covered by the waters of an artificial lake created by the predecessor in title of both plaintiff and defendant, the plaintiff was entitled to the use of all of the lake waters. Such entitlement was said to be in the nature of an easement, the court stating that the plaintiff need not be a riparian owner of a navigable stream to qualify as the holder of such easement. Moreover, it was held unnecessary for the lake in question to be dedicated to public use. The lower court decree granting the injunction was affirmed. (Caldwell-Florida)
W70-06496

MEDLOCK V GALBREATH (OWNERSHIP OF BEDS OF NON-NAVIGABLE WATERS AS CONTROLLING RIGHT TO REGULATE FISHING IN THOSE WATERS).
187 SW2d 545-547 (Ark 1945).

Descriptors: *Arkansas, *Non-navigable waters, *Fishing, *Ownership of beds, Streambeds, Surface waters, Commercial fishing, Fish migration, Fish passage, Boundaries (Property), Navigable waters, Judicial decisions, Legal aspects, Beds, Beds under water, Bodies of water, Fish, Relative rights, Water rights, Land use, Reparian rights, Remedies.

Defendants, owners of a portion of the bed of a non-naviagable waterbody, appealed a decision enjoining them from interfering with the commercial fishing operations of plaintiffs in the waters over defendants' beds. The court concluded that owners of beds of non-navigable waters have a right to control that part of the surface of the water above their beds, even to the extent of fencing off their respective portions. However, defendants had not marked off their portion, and because the body of water had both inflowing and outflowing streams through which fish could freely migrate in either direction, defendants were held to have no ownership in the fish. The court therefore held that under these facts the plaintiffs had a right to conduct lawful fishing operations in the waters over defendants' beds and defendants could be enjoined from interfering with these operations. (Caldwell-Florida)
W70-06498

MERRITT V PALMER (BOUNDARY DISPUTE WHERE CREEK AND SWAMP FORMED BOUNDARIES).
158 SW2d 163-166 (Ky 1942).

Descriptors: *Kentucky, *Boundary disputes, *Boundaries (Property), *Watercourses (Legal), Meanders, Streams, Swamps, Maps, Mapping, Surveys, Judicial decisions, Legal aspects, Land tenure, Water levels, Channels, Channel flow, Bodies of water, Channel morphology.

A dispute arose over the location of the true boundary line between two farms. The creek forming the boundary line in places spread out and formed a swamp with no discernable channel. A survey was ordered by the court but was excepted to by the parties and was thrown out. The court held that where there was a conflict between the meanders of the stream and the description in the deed, the location of the stream prevails. The determination of the boundary in swampland areas, and whether the creek had a defined channel at a particular spot were for determination by the trial court and would not be disturbed. (Caldwell-Florida)
W70-06499

WATER FOWL ON SHARK RIVER PROTECTED; PENALTY.
NJSA sec 23:9-98 (1940).

Descriptors: *New Jersey, *Water fowl, *Hunting, *Birds, Aquatic life, Animals, Legislation, Legal aspects, Wildlife, Ducks (Wild), Animal groupings, Bird types, Game birds, Shore birds, Water birds, Rails.
Identifiers: Penalties (Criminal).

It is unlawful for any person, on the Shark River, to shoot, hunt, kill, destroy or injure any: (1) anatidae, commonly known as swans, geese, brant and river and sea ducks; (2) rallidae, commonly known as rails, gallinules, coots and mud hens; and (3) limicolae, commonly known as shore birds or surf or bay snipe. A penalty of twenty-five dollars per offense is provided. (Powell-Florida)
W70-06500

CITY OF PRINCETON V MARTIN (PROPERTY BOUNDARIES OF RIPARIAN LAND).

170 SW 2d 660-661 (Ky 1943).

Descriptors: *Kentucky, *Boundary disputes, *Boundaries (Property), *Riparian land, Riparian rights, Judicial decisions, Legal aspects, Banks, Streams, Navigable waters, Cities, Assessments, Watercourses (Legal), Beds, Channels.

The plaintiff municipality improved a city street and assessed the abutting property owners therefor. A creek bordered the street on the west and bor-

dered defendant's land on the east. The plaintiff city assessed the defendant's land which the plaintiff contended fronted on the west side of the street. Defendant contended that he owned only to the west bank of the creek by virtue of his predecessor's deed. Plaintiff brought suit to recover the unpaid balance of the special assessment for street improvement. The plaintiff contended that even if defendant's line ran to the thread of the creek, his property would still front on the street, because the stream constituted a part of the street. The appellate court, in affirming the trial court's judgement for defendant, held that where land is granted on a fresh water stream, the line extends to the thread of the main channel unless it is clear from the grant that the intention was otherwise. The court determined that the defendant's predecessors in title could not convey property beyond the center of such creek. The land was not subject to a special assessment for street improvements. (Powell-Florida)
W70-06501

BROWN V WILSON (ACCRETION INVOLVING A CHANGE OF STREAM FLOW--PROPERTY RIGHTS).
155 SW2d 176-180 (Mo 1941).

Descriptors: *Missouri, *Accretion (Legal aspects), *Boundaries (Property), *Boundary disputes, Ownership of beds, Streams, Rivers, Shores, Riparian rights, Costs, Streamflow, Alteration of flow, Legal aspects, Non-navigable waters, Islands, Judicial decisions, Marshes, Wetlands, Relative rights.
Identifiers: *Sloughs.

Plaintiff owned a tract of land bounded on the north by a non-navigable stream. Defendant owned an adjacent tract bounded on the south by the same stream. Warranty deeds to both tracts described the stream as the northern and southern boundaries respectively. A dispute arose concerning the ownership of a small portion of land lying between the main channel of the stream to the north and a slough to the south which had constituted the main channel until about thirty years before the litigation. The slough remained a distinct channel, and during times of high water a part of the river flowed through it. The evidence was unclear as to whether the stream had changed course suddenly or gradually, though there was substantial evidence showing that the tract in question once was a distinct island with water flowing through both channels. The issue was whether the disputed land accreted to the plaintiff. The court held that adjacent landowners whose property is divided by a non-navigable stream own to the center or thread of the stream, and where a subsequent change in the course of the stream occurs through the gradual process of accretion, the boundary line changes with the stream. But when the stream changes course suddenly or in such a manner as not to destroy the identity of the land between the two channels, the process is not one of accretion, and the boundary line is unchanged. The trial court's finding in favor of the latter situation was upheld. (Clarke-Florida)
W70-06502

BROWN V WILSON (OWNERSHIP OF LAND AFTER STREAM AVULSION).

131 SW2d 848-852 (St Louis Ct App Mo 1939).

Descriptors: *Missouri, *Boundaries (Property), *Accretion (Legal aspects), *Land tenure, Land farming, Land use, Legal aspects, Real property, Boundary disputes, Water law, Rivers, River flow, Judicial decisions, Avulsion, Relative rights.

A river bounds plaintiff's land on the north and defendant's land on the south. The river now flows in a channel farther north than previously. Plaintiff brought an action of ejectment, alleging that the change in course of the river was so gradual as to make the property to the south of its new course an accretion to plaintiff's land. Defendant claimed that the change in course of the river was sudden, and that the uncovered property had lost none of its distinction. Consequently, the property was not accreted to plaintiff's property. Furthermore, even if the property was an accretion defendant had acquired right to possession by adverse possession. The lower court refused to eject defendant and plaintiff appealed. At on point in the change in channels of the river the disputed property was a distinct island, tending to refute plaintiff's characterization of the land as accretion. Defendant had been in notorious possession of the property for a period greater than that necessary to obtain title by adverse possession. The court held there was ample evidence to allow the lower court to find for defendant on the basis of either of his claims. (Dye-Florida)
W70-06503

IRWIN SAVINGS AND TRUST CO V PENNSYLVANIA RY CO (DROWNING IN POND CREATED BY OBSTRUCTED CULVERT).
32 A2d 432-443 (Penn 1944).

Descriptors: *Pennsylvania, *Railroads, *Obstruction to flow, *Culverts, Damages, Judicial decisions, Bodies of water, Drains, Surface drainage, Watercourses, Embankments, Diversion, Structures, Standing waters, Ponds, Legal aspects, Drowning, Ice.

The defendant railroad failed to unstop a culvert under one of their embankments, and water backed up to form a pond. Four children fell through the ice and drowned. Plaintiff sought damages. The court first held that a pool backed up by defendant onto a third-party's land is not an attractive nuisance where there is no unusual danger. While the defendant was negligent in allowing the pond to form, such negligence was not the proximate cause of the drownings, since the drownings were not reasonably forseeable. The defendant was therefore not liable. The court further stated that any duty of the railroad not to allow water to back up onto another's land was owed to the owner of the land and did not run to the children. The dissenting opinion contended that a duty ran to the public to keep the culvert open and would have found defendant liable. (Caldwell-Florida)
W70-06504

GOFORTH V WILSON (RIPARIAN BOUNDARIES ON SHIFTING NON-NAVIGABLE STREAM).
184 SW2d 814-816 (Ark 1945).

Descriptors: *Boundaries (Property), *Avulsion, *Accretion (Legal aspects), *Boundary disputes, Riparian rights, Alteration of flow, Low water mark, Non-navigable waters, Legal aspects, Streams, Land tenure, Watercourses (Legal aspects), Channels, Riparian land, Rivers, Islands, Relative rights, Judicial decisions, Navigable waters.

The plaintiffs had inherited land with a non-navigable stream as a boundary line; they used defendants claiming that the non-navigable stream had changed course by an avulsion in 1943 and, as between them and the defendants, the main channel existing in 1938 rather than the present channel, remained the boundary. The court ruled that navigability of a stream is a question of fact and that riparian owners upon a non-navigable stream own to the center of the stream ratably with other owners. When a stream changes course by accretion, the boundaries change with the stream. When the stream shifts by avulsion, the boundaries do not change. The test is whether change is gradual or sudden. Plaintiffs had the burden of showing avulsion and had failed to do so. The boundary therefore remained the present center of stream. (Leesfield-Florida)
W70-06599

WARNER V CLARKE (RIGHT TO ENT PRIVATE LAND ADJACENT TO NAVIGA WATERS).
232 So2d 99-103 (La App 1970).

Descriptors: *Louisiana, *Public rights, *Ripa rights, *Navigable waters, Legal aspects, Judi decisions, Navigable rivers, Streams, Lakes, I ous, Banks, Levees, Ponds, Fishing, Hunting, Cl nels, Mississippi River, Land, Land use, L tenure, Remedies, Relative rights.
Identifiers: *Riparian servitude, Penal (Criminal).

Plaintiffs, Louisiana residents, brought suit aga the parish district attorney for a declarat judgment declaring certain lands to be subjec public use. Plaintiffs desired to hunt and fish lands which were owned by private persons. lands were located along the Mississippi and c tained navigable waters. Plaintiffs based their cl on a state law which gave the public the right to up vessels on the banks of navigable streams rivers. The trial court ruled that plaintiffs did have the right to enter upon these lands for hun and fishing purposes. The court of appeals firmed, noting that riparian servitudes are not s ject to broad interpretation, but exist only for which is incident to the nature and naviga character of streams flowing on proprietor's la Thus the statute could not be construed to plaintiffs the right to hunt and fish on private la The court also noted that a declaratory judgm was an improper remedy since none of the downers was made party to the suit. (Duss-Flori W70-06613

PARADA V UNITED STATES (RIPARIAN IN RY CAUSED BY NEGLIGENT OPERATION FEDERALLY OWNED CANAL).

420 F2d 493-495 (5th Cir 1970).

Descriptors: *Texas, *Federal governm *Gophers, *Irrigation, Operation and ma tenance, Riparian rights, Check structures, Irri tion canals, Legal aspects, Judicial decisio Riparian land, State governments, Water delive Flood control, Control structures, Diversion str tures, Flood damage, Inspection, Flood protecti Overflow, Leakage, Canal seepage.

Plaintiff's land was damaged by water flowing fr a break in an irrigation canal constructed maintained by defendant Bureau of Reclamatio the United States Department of the Interior. evidence showed that the break was caused by burrowing of gophers, that defendant had responsibility of maintaining the canals, and t defendant's agents had not inspected the area the break during the four months prior to break, although fully aware of the gopher proble Plaintiff contended that defendant was negligen and that its negligence was the proximate cause plaintiff's injuries. Defendant claimed that break was caused by the burrowing of goph which was an act of God. The court held that fendant was derelict in its duty to maintain canal. Defendant was fully aware of the gopher tivity in the area; thus the sudden unforeseeab catastrophic character of an act of God could be attributed to the burrowing of the gophers. fendant's failure to inspect the area was the pro mate cause of the break, and it could h reasonably foreseen that such failure to insp would lead to a break which would cause flo damage to neighboring lands. (Clarke-Florida) W70-06654

BERO V STATE (PROCEEDING IN EMINE DOMAIN TO ESTABLISH JUST COMPENS TION).
305 NYS2d 309-312 (1969).

Descriptors: *New York, *Eminent doma *Gravels, *Appraisals, Highways, Drainage, Ju cial decisions, State governments, Legislati

nks, Navigable rivers, Damages, Local governnts, Easements, Ownership of beds, Road conuction, Right-of-way, Negotiations, Legal ects, Permits, Bank erosion, Administration, er beds, Roads, Roadbank.

e state under its power of eminent domain apopriated lands for the construction of an instate highway. Due to the location of the connned land, a 27.05 acre gravel area including a 2 acre drainage easement was diminished in ue. The state conceded the entire land area inding a .382 acre streambed under an adjacent er was rendered valueless. Claimant's and state's praisal experts differed as to the value of the d. Appraisals were made on the basis of the sale comparable lands located nearby. The state aled that an erroneous award had been made ed on a valuation of gravel-excavation land ues for acreage under and on the banks of the acent river; the plaintiff was prohibited from lizing such gravel except by special permit. The urt held that claimant's failure to prove legal pacity to make use of the riverbed and bank for ging and removal required damages to be meaed by the next highest use. Based on such next hest use, the award below was excessive. (Bart-Florida)
70-06657

YLIE V WOOLDRIDGE (DAMAGES FOR, ID INJUNCTION TO, PREVENT EXCAVAON AND FILL).
7 SW2d 851-856 (Ark 1969).

scriptors: *Arkansas, *Riparian rights, *Bounry disputes, *Excavation, Judicial decisions, nd use, Legal aspects, Land clearing, Land velopment, Land forming, Land management, ainage, Flood control, Water conservation, Land ure, Real property, Landfills, Bays, Inlets aterways), Lakes, Littoral, Channels, ckwater, Remedies, Contours.

aintiff's land bordered on the 400 foot contour e of a lake and was separated from defendant's nd by a channel of the lake's backwater. Plaintiff ntended that the defendants, in clearing their nd and preparing a channel in their property, ed a portion of the lake below the 400 foot line, ereby cutting off the plaintiff's lake frontage. The urt held for defendant and plaintiff appealed. e appellate court held that defendants did not t off any of plaintiff's lake frontage. Moreover, e lower court's finding that ownership of the sputed area remained in defendants did not contute adjudication of ownership where ownership s not in question and findings did not establish at the court intended to make a determination of nership. (Barnett-Florida)
70-06662

ATTON PARK V POLLAK (EASEMENT IN AKE CREATED BY IMPOUNDMENT OF ON-NAVIGABLE STREAM).
NE2d 328-332 (Ind Ct App 1944).

escriptors: *Indiana, *Lake beds, *Easements, mpounded waters, Surface water, Beds, Ownerip of beds, Judicial decisions, Legal aspects, emedies, Lakes, Riparian rights, Streams, Dams, ater rights, Preferences (Water rights), Competg uses, Water contracts, Water law, Impoundents, Land tenure, Non-navigable waters.

e owner of lands upon which there was located a n-navigable stream granted on easement to the unty for the creation, operation and mainnance of a lake. A dam was constructed which pounded the lake waters and thereby submerged nds of the owner. The county then transferred its sement to plaintiff park association, and the ner of the submerged lands then conveyed his operty to the defendant. The defendant had owledge of plaintiff's easement by record notice d personal investigation. Defendant began to use e lake waters without compensating plaintiff. Plaintiff sought to enjoin defendant from so using the waters of the lake. A judgment for defendant was reversed by the Indiana Appellate Court. The court held that the plaintiff was entitled to enjoin defendant from going upon the lake waters without paying for the privilege. The court reasoned that the easement transferred to plaintiff gave to the grantee the sole right and authority to manage and control the lake. Also, the defendant, purchaser with knowledge of property from a grantor who had previously granted an easement, took title subject to such easement. (Powell-Florida)
W70-06714

LICENSES AND PERMITS (LICENSES REQUIRED FOR HUNTING, TRAPPING AND FISHING).
Conn Gen Stat Ann secs 26-27, 26-46 (1960), as amended, (Supp 1969).

Descriptors: *Connecticut, *Permits, *Fish conservation, *Wildlife, Fishing, Commercial fishing, Sport fishing, Fish, Recreation, Legislation, Legal aspects, State governments, Regulation, Game birds, Inland waterways, Hunting, Waterfowl, Boats, Trapping, New York, Massachusetts, Rhode Island, Administration, Riparian rights.

No person over sixteen years of age shall take, hunt or trap, any animal or fish in the inland waters of this state without a license. Any domiciled landowner of this state, may hunt, trap or fish without a license on land owned or leased by him as long as he is actually domiciled there. No license is required for the oarsman or motor operator of a boat from which others are fishing. If and when the states of New York, Rhode Island and Massachusetts enact a law similar to this granting reciprocal fishing privileges, the residents of those states may fish in waters lying partly in this state and partly in the adjoining state without obtaining a non-resident fishing license. All other applicable laws of this state shall be in effect with regard to such persons. (Barnett-Florida)
W70-06716

MILLER V LUTHERAN CONFERENCE AND CAMP ASS'N (RIGHTS OF BOATING, FISHING AND BATHING IN AN ARTIFICIAL LAKE).
200 A 646-652 (Penn 1938).

Descriptors: *Pennsylvania, *Prescriptive rights, *Artificial watercourses, *Riparian rights, Easements, Judicial decisions, Legal aspects, Water rights, Artificial use, Ownership of beds, Relative rights, Riparian land, Recreation, Navigable waters, Fishing, Boating, Lakes, Boundaries (Property), Streams, Fresh water, Lake beds, Navigation, Swimming.

A corporation leased with exclusive water rights plaintiff's submerged land. The corporation then granted plaintiff the exclusive right to fish and boat in the lake. Plaintiff assigned his brother a 1/4 interest in the fishing, boating and bathing rights. Plaintiff and his brother operated boat and bath houses on the lake. The executor's of the brother's estate gave a license to defendant association for boating, fishing and bathing in the lake. Defendant owned property abutting the lake. Plaintiff sought to enjoin defendant from trespassing on the submerged land and from granting any bathing licesnes. The Pennyslvania Supreme Court affirmed the injunction decree against the defendant and held that without the common consent of plaintiff and his brother their water rights could not be commercially used, and licenses could not be issued to defendant. The court determined that plaintiff acquired the boating and fishing privileges by grant and that plaintiff and his brother acquired the bathing privilege by prescription. The court observed that in this case of a non-navigable lake, where the land under water was owned by others, no riparian rights attached to defendant's property bordering on the water. (Powell-Florida)
W70-06724

MCCLURE V COUCH (AVULSIONS AND ACCRETIONS).
188 SW2d 550-555 (Tenn 1945).

Descriptors: *Tennessee, *Avulsion, *Accretion (Legal aspects), *Boundaries (Property), Judicial decisions, Legal aspects, Bank erosion, Channels, Alluvial channels, Channel flow, Rivers, Acreage, Riparian rights, Riparian land, Land tenure, Streamflow.

A violent avulsion occurred in the river bordering the west end of the farm owned by plaintiff's father. The sudden change of the stream channel cut off a portion of the west end of the farm and created an island. The old river bed was still distinct. Plaintiff's father devised to plaintiff a portion of the farm, including two or three acres on the new island. After the avulsion, accretions totaling 27 acres were deposited against the southern border of plaintiff's island tract. Plaintiff claims the 27 acres by reason of the law controlling accretions and adverse possession. Defendant, whose land bordered the west side of the old channel of the river, claimed the accretions, also. The Supreme Court of Tennessee held that plaintiff owned the 27 acres of accretions. The court reasoned that: (1) plaintiff was the owner of the tract against which the accretions accumulated; (2) avulsion did not change the farm boundary which remained the middle of the old channel; (3) plaintiff held the major portion of the accretions by adverse possession for the requisite period; and (4) none of the accretions ever touched the property owned by the defendant. (Powell-Florida)
W70-06725

FIFE V LOCKHART (BOUNDARY DISPUTE OF LAND LOCATED AT JUNCTION OF CREEKS).
286 Ky 311, 150 SW2d 487-488 (Ky 1941).

Descriptors: *Kentucky, *Boundary disputes, *Boundaries (Property), *Alteration of flow, Bank erosion, Water law, Judicial decisions, Avulsion, Legal aspects, Streams, Streamflow, Bridges, Structures, Landfills, Junctions, Tributaries, Accretion (Legal aspects), Land tenure.

A dispute arose between plaintiff and defendant, adjoining landowners, over the ownership of a small tract of land located at the junction of two creeks. Plaintiff brought an action of ejectment against the defendant. Plaintiff contended that the building of a bridge had caused a shift in the course of one stream and thereby took land from her property and added it to defendant's property. Plaintiff contended that subsequently the bridge washed out and the creek shifted back to its original course. The appellate court held that the evidence as to any substantial shifting of the creek from its original bed was so unsatisfactory that the trial court propertly refused to submit the issue to the jury. The court also held that the plaintiff had no record title to the land and had failed to establish adverse possession. (Hubener-Florida)
W70-06726

RICHARDSON V HORN (PERMISSIVE EASEMENTS ACROSS ADJOINING LAND).
137 SW2d 394-398 (Ky 1940).

Descriptors: *Kentucky, *Easements, *Prescriptive rights, *Sewers, Adjudication procedure, Contracts, Judicial decisions, Legal aspects, Overlying proprietor, Relative rights, Water rights, Drains, Pipes, Plumbing, Drainage systems, Land tenure.
Identifiers: *Permissive use.

In 1919 a prior owner of plaintiff's land allowed the defendant to build a sewer pipe across the land; the pipe connected into a sewer on the land pursuant to a written agreement indicating that the sewer pipe would be removed if the owner of the land or any vendee thereof objected to it. In 1938, plaintiff, a distant vendee of the servient land, gave notice to defendant, owner of the dominant land, that in accordance with the agreement, the plaintiff desired the removal of the sewer pipe. The action went to

court for a declaration of the rights of the parties. The court held that in the absence of the permissive agreement, defendant would have acquired a prescriptive right to the easement over plaintiff's land. However, when the use of another's land is originally acquired by permission, the character of the use is established and it continues to be permissive until notice is brought to the owner of the land that the character of the use has been changed. Defendant's use of plaintiff's land was permissive, and plaintiff had the right to terminate such use. (Clarke-Florida)
W70-06727

HART V COPPER DIST POWER CO (SUIT FOR BREACH OF WATER-RIGHTS CONTRACT).

289 Mich 150, 286 NW 191-197 (Mich 1939).

Descriptors: *Michigan, *Water contracts, *Water rights, *Claims (Contracts), Relative rights, Land tenure, Land use, Water utilization, Legal aspects, Lakes, Water levels, Flooding, Flow, Economics, Negotiations, Contracts, Performance, Judicial decisions.

Plaintiff and defendant company entered into an agreement whereby defendant was given the option to purchase certain water rights relating to the use of water in a lake. Defendant later agreed to exercise the option, but then sought a modification in price terms before paying any money. Much correspondence between the parties ensued, at the culmination of which defendant disclaimed all obligations under the agreement and claimed that plaintiff had terminated the option. The court held that the plaintiff had not terminated the option, and that defendant had committed a breach of contract. It was found that the correspondence consisted chiefly of demands for payment by plaintiff and requests for time extensions by defendant. As plaintiff had properly tendered the deeds to the water rights, she was entitled to recover. (Caldwell-Florida)
W70-06728

BURKMAN V CITY OF NEW LISBON (PRESCRIPTIVE RIGHT TO FLOOD LAND NEAR DAM).
246 Wis 547, 19 NW2d 311-315 (Wis 1945).

Descriptors: *Wisconsin, *Dams, *Flooding, *Prescriptive rights, Dam construction, Public utilities, Mill dams, Hydraulic structures, Land tenure, Hydroelectric power, Lakes, Flow, Relative rights, Cities, Damsites, Legal aspects, Judicial decisions, Easements, Multiple-purpose reservoirs, Operation and maintenance.

Plaintiffs sought a declaration that the action of defendant city in constructing and maintaining a dam, thus flooding considerable property, was wrongful. The damsite when acquired by the city had lain unused for more than 30 years, although a mill dam had been there earlier. The city claimed that the right to flood surrounding land had been acquired by prescription by defendant's predecessors in title, and argued that no finding had been made by the trial court that this right had been abandoned. The Supreme Court of Wisconsin held that only the right to flood lands for a mill dam had been acquired by prescription, and the city had expressly given up the right to operate such dam by the terms of the deed. As the present reservoir was for a different purpose than providing a head for a mill dam, no prescriptive right for it had been acquired. Further, the period of nonuse of the damsite was held to be strong evidence of an intent to abandon any right that had originally been acquired. The city's action in building the dam and flooding the property was thus wrongful. (Caldwell-Florida)
W70-06729

6F. Nonstructural Alternatives

FLOODS IN HAMPSHIRE QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Oak Park, Ill.
Roman T. Mycyk, and Marvin D. Duerk.
Geological Survey Open-file report, June 1969. 13 p, 10 fig, 1 plate, 1 ref.

Descriptors: *Floods, *Illinois, Profiles, Maps, Data collections, Planning, Flood control, Flood plain zoning, Water management (Applied), Stage-discharge relations, Streamflow.
Identifiers: Hampshire quadrangle (Ill), Peak flow.

This report presents hydrologic data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Hampshire quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving the existing flood problems and for formulating effective flood-plain regulations that will minimize the creation of new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facilities, developing recreational areas, and managing surface water in relation to the groundwater resources. The approximate areas inundated by floods along streams in the Hampshire quadrangle are delineated on a topographic map. The general procedure used in defining flood boundaries was to construct flood profiles from elevations of flood-marks identified in the field and from data available from other agencies. (Knapp-USGS)
W70-06351

FLOOD PLAIN INFORMATION, DEKALB COUNTY, GEORGIA.
Corps of Engineers, Savannah, Ga.
For primary bibliographic entry see Field 04A.
W70-06568

6G. Ecologic Impact of Water Development

GEOLOGIC INVESTIGATION OF THE SITE FOR AN ENVIRONMENTAL POLLUTION STUDY,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 05C.
W70-06322

GEOLOGICAL INFORMATION FOR MANAGING THE ENVIRONMENT,
Illinois State Geological Survey, Urbana.
John C. Frye.
Illinois State Geological Survey Environmental Geology Note No 18, November 1967. 12 p, 1 ref.

Descriptors: *Planning, *Urbanization, *Environmental engineering, *Reviews, Engineering geology, Hydrogeology, Waste disposal, Water supply, Landfills, Water resources development, Mapping.
Identifiers: Environmental management.

The application of geologic data to solutions of problems encountered on construction projects, environmental applications, and groundwater development are reviewed. Only in the present decade has a general realization developed that--in spite of the program for the exploration of space--the physical limitations of the Earth's crust and its resources are relatively permanent as far as man's destiny is concerned. This realization, especially on the part of geologists and planners, as well as of other officials in a position to utilize the data geologists can provide, now gives promise that man will in the future be better able to cope with the environmental problems arising from the population explosion. (Knapp-USGS)
W70-06403

PULL-UP TRAP: A QUANTITATIVE DEV FOR SAMPLING SHALLOW-WA ANIMALS,
Geological Survey, Miami, Fla. Water Resou Div.
For primary bibliographic entry see Field 07B.
W70-06404

URBAN ENERGY BALANCE CLIMATOLOG
California Univ., Los Angeles. Dept. of Geogra
For primary bibliographic entry see Field 02B.
W70-06516

THE EVERGLADES: A THREATENED ECO GY,
Miami Univ., Fla. Inst. of Marine Science.
C. P. Idyll.
Science Journal, Vol 5A, No 2, p 66-71, Au 1969. 6 p, 5 photo, 5 ref.

Descriptors: *Wetlands, *Freshwater mars *Florida, *Aquatic environment, Land recla tion, Drainage, Environmental effects, Drough sistance, Habitats.
Identifiers: *Everglades.

The central part of the lower Florida peninsu covered by an area unique in the world-the E glades. This is an intermittent slowly flowing r 180 km long, with banks as much as 100 km a and an average depth as little as 30 cm over g stretches. The nearly imperceptible flow (ab 500 meters a day) and the immense expanse of Everglades water are consequences of the extre ly low relief of this region. Changes in the w level beginning early in this century with drai for agriculture, and continuing at an accelera pace with recent flood control projects, threatening to destroy the natural balance of life in the Everglades. Severe droughts--the r recent lasting from 1961 to 1965--have been gravated by the flood control measures. Meas to conserve the water and thus the natural veg tion and the animals that live in it are now urge needed. (Knapp-USGS)
W70-06539

FLOOD PLAIN INFORMATION, LITT TIMBER CREEK, CAMDEN COUNTY, N JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W70-06543

ECOLOGICAL CONSEQUENCES OF T MANAGEMENT OF CATCHMENT AREAS A INFLUENCE OF FORESTS ON RIVER BASIN
For primary bibliographic entry see Field 04D.
W70-06569

07. RESOURCES DATA

7A. Network Design

NON-METROPOLITAN DENSE RAINGA NETWORKS,
American Society of Civil Engineers, New York
For primary bibliographic entry see Field 02B.
W70-06317

EVALUATION OF THE SURFACE-WAT DATA PROGRAM IN KANSAS,
Geological Survey, Lawrence, Kans. Wa Resources Div.
P. R. Jordan, and E. R. Hedman.
Kansas Water Resources Board Bulletin No 1970. 49 p, 10 fig, 7 tab, 10 ref, 2 append.

Descriptors: *Data collections, *Evaluati *Statistical methods, *Statistics, Kansas, Qua control, Sampling, Measurement, Stations, Fac ties, Instrumentation, Networks, Sites.
Identifiers: Kansas surface-water data network.

curacy goals for surface-water gaging statistical ormation on Kansas are, for principal streams, uracy equivalent to that of a 25-year record and other streams, accuracy equivalent to that of a yr record. For principal streams, the accuracy l can be met by operation of gaging stations for yr at appropriate sites. For other unregulated ams draining more than 150 square miles, the uracy goal can be met for medium and high ws by use of the relations between streamflow racteristics and drainage basin characteristics. w-flow characteristics can be determined by eration of low-flow partial-record stations. eration of about 100 low-flow partial-record sta- ns is recommended; stations can be moved to v sites after a wide range of low flows have been asured. Many complete-record stations can be continued unless they are needed for current- pose data. For streams draining less than 150 sq gaging should be continued for basins having a iety of physical and climatic characteristics to vide data for development of generalization thods. Continuation of a network of about 100 h-flow partial-record stations is recommended a period of at least 5 yr. (Knapp-USGS)
70-06330

TIONAL REFERENCE LIST OF WATER ALITY STATIONS - WATER YEAR 1970.
ological Survey, Washington, D.C. Water sources Div.
r primary bibliographic entry see Field 05A.
70-06514

YDROLOGICAL NETWORK DESIGN EEDS, PROBLEMS AND APPROACHES,
C. Rodda, W. B. Langbein, A. G. Kovzel, D. R. wdy, and K. Szestay.
mmary in French, Russian, and Spanish. World eteorological Organization Report No 12, 1969. p, 14 fig, 6 tab, 119 ref.

escriptors: *Network design, *Hydrologic data, Data collections, Data processing, Planning, Re- onal analysis, Remote sensing, International ydrological Decade, Data transmission, Instru- entation.
entifiers: Hydrologic networks, Data require- ents.

etwork design enters into most aspects of drology; consequently, it is a topic which merits nsiderable attention. Lack of necessary attention sults from difficulties in demonstrating the value scientific design, problems of defining and classi- ng hydrological networks, and several other fac- rs, including the absence of clear and concise ob- ctives. Methods of design apply the concepts of gionalization, mapping and systems analysis, but e most sound design criteria are economic ones. here are no relevant economic data from net- rks. Some countries possess networks or plans r them which can serve as models for others. It is ident, however, that approaches to design are ely to enter a new phase of development in the ar future, with the routine use of artificial satel- es, automatic weather stations and computers for aspects of data processing and analysis. This re- rt is concerned with these and other matters per- ient to hydrological network design. It seeks to esent the topic critically and cautiously as a re- inder that much has still to be accomplished. (K- pp-USGS)
70-06550

B. Data Acquisition

PPLICATION OF RUN-LENGTHS TO YDROLOGIC SERIES,
olorado State Univ., Fort Collins. Dept. of Civil ngineering.
r primary bibliographic entry see Field 02E.
70-06332

MACRO-TURBULENCE MEASUREMENTS IN NATURAL STREAMS,
Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics.
For primary bibliographic entry see Field 02E.
W70-06387

THE EFFECT OF AXIAL VELOCITY FLUCTUATIONS ON THE RESPONSE OF A HELICAL FLOW METER,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-06388

TURBULENCE MEASUREMENT BY MEANS OF SMALL CURRENT METER IN FREE SURFACE FLOW,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
Yoshiaki Iwasa, and Hirotake Imamoto.
French summary included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B32, p 273-280, 1967. 8 p, 4 fig, 1 tab, 2 ref.

Descriptors: *Instrumentation, *Turbulence, *Current meters, Flow measurement, Turbulent flow, Flowmeters, Water measurement.
Identifiers: *Turbulence meters.

Equipment was designed for the measurement of temporal variation in local velocities by means of a small current meter in free surface flows. Possible use of the equipment in experimentations for turbulence measurements is discussed with observational comparisons with other methods of measurement. The mathematical analysis and observations show that the method of measurement is quite effective in obtaining the intensity of turbulence whereas it is not suitable to measure a turbulence spectrum. The effective averaging time for the intensity of turbulence is 0.1 sec and the actual total sampling time 100 sec. (Knapp-USGS)
W70-06389

EXPERIENCE WITH TURBULENCE METERS AND THEIR IMPROVEMENT,
Technische Hochschule, Munich (West Germany). Hydraulics Research Station Obernach.
Fritz Hartung, and Klausotto Csallner.
French summary included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B31, p 264-272, 1967. 9 p, 10 fig, 1 ref.

Descriptors: *Instrumentation, *Turbulence, *Current meters, Flow measurement, Turbulent flow, Flowmeters, Water measurement.
Identifiers: Turbulence meters.

Two turbulence meters can be used for qualitative and quantitative measurements within the macroturbulent area of fluids. The meters are of relatively simple design and can be produced at almost any size according to the purpose of application. They are even suitable for measurements in models. The turbulence meters operate on the basis of the induction principle. Small deflections of a metal platelet caused by transverse turbulent movements are measured by electronic equipment. (Knapp-USGS)
W70-06390

MEASUREMENT METHODS OF MACROTURBULENCE,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
Sahap Aksoy.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B30, p 256-263, 1967. 8 p, 7 fig, 1 ref.

Descriptors: *Instrumentation, *Turbulence, *Flowmeters, Vortices, Flow measurement, Turbulent flow, Calibrations, Anemometers.
Identifiers: Electrokinetic anemometers, Turbulence transducers.

An electrical-electronical system for the determination of turbulence by force transducer is described. The detecting element has a circular area of 5 mm diameter. The characteristics of the measured turbulence will be related to the size of the detecting device. Detection is based on the variation in the acting force on a deflected electrode. The principles and the description of the measuring system are given here and the application is demonstrated by an example. (Knapp-USGS)
W70-06391

POTENTIAL FLUCTUATIONS GENERATED BY TURBULENCE ON A SMALL WIRE,
Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
Gilbert Binder.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B29, p 249-255, 1967. 7 p, 6 fig, 6 ref.

Descriptors: *Instrumentation, *Flowmeters, *Turbulence, *Vortices, Flow measurement, Turbulent flow, Calibrations, Anemometers.
Identifiers: Electrokinetic anemometers, Turbulence transducers.

A new electrokinetic turbulence transducer is described and its physical mechanism is explained. Some turbulence measurements performed with this transducer are presented. Its limitations and possible applications are discussed. (Knapp-USGS)
W70-06392

AN INVESTIGATION OF WATER SURFACE TEMPERATURE BY AN AIRBORNE INFRARED RADIOMETER: LAKE HEFNER, OKLAHOMA,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 03B.
W70-06400

PULL-UP TRAP: A QUANTITATIVE DEVICE FOR SAMPLING SHALLOW-WATER ANIMALS,
Geological Survey, Miami, Fla. Water Resources Div.
A. L. Higer, and M. C. Kolipinski.
Ecology, Vol 48, No 6, p 1008-1009, Autumm 1967. 2 p, 2 fig, 1 tab, 2 ref.

Descriptors: *Trapping, *Aquatic populations, *Marshes, *Florida, Fish, Biota, Ponds, Habitats.
Identifiers: Pull-up trap, Shallow ponds, Everglades National Park.

A trap was designed for providing quantitative samples of freeswimming animals in marshes and shallow ponds. The device consists of netting tied to an aluminum frame with attachments for rapidly raising the net and entrapped organisms out of the water. Collections from a series of pull-up traps, operated monthly in Everglades National Park, provide an index of fluctuations in aquatic animal populations. (Lang-USGS)
W70-06404

FRESH WATER WHITECAPS,
Hobart and William Smith Colleges, Geneva, N.Y.
For primary bibliographic entry see Field 02L.

W70-06459

REVIEW OF NEW GEOGRAPHIC METHODS AND TECHNIQUES. QUESTIONNAIRE SURVEY. WATER RESOURCE PLANNING AND MANAGEMENT. RECENT TRENDS IN REMOTE SENSING TECHNOLOGY,
Florida Atlantic Univ., Boca Raton. Dept. of Geography.
For primary bibliographic entry see Field 06B.
W70-06466

TWO METHODS OF DESCRIBING THE 'AVERAGE' VERTICAL TEMPERATURE DISTRIBUTION OF A LAKE,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
For primary bibliographic entry see Field 02H.
W70-06665

7C. Evaluation, Processing and Publication

USE OF DIGITAL COMPUTERS IN PROCESSING, PUBLISHING, AND ANALYZING HYDROLOGIC DATA,
Geological Survey, Washington, D.C.
W. L. Isherwood.
Nordic Hydrology, Vol 1, No 1, p 38-55, 1970. 18 p.

Descriptors: *Data processing, *Hydrologic data, *Digital computers, Data storage and retrieval, Data collections, Computer programs, Statistical methods, Documentation, Groundwater, Surface waters, Water levels, Streamflow, Sediment load, Water quality, Floods, Estuaries.
Identifiers: U.S. Geological Survey.

The use of digital computers for processing hydrological data is discussed. Digital computers have been used by the United States Geological Survey, Department of the Interior, for processing, publishing, and analyzing hydrologic data since 1956 when the first one was installed by the agency. Beginning with a few relatively simple applications to hydrology in 1956, the use of computers in this field has rapidly expanded until at present over 100 different applications are being used routinely by this agency and it is now difficult even to catalog all the various uses, particularly those in the research fields. Descriptions are given of computer processing of large masses of regularly observed basic hydrologic data from field collection, through editing and conversion to useful form, its rearrangement and summarization for periodic publication, and its entry into large computer-based storage and retrieval systems. Only a few basic ststistical analyses, these performed routinely on large blocks of data, are discussed. (Knapp-USGS)
W70-06329

CALCULATION OF SPECTRA OF TURBULENT PULSATIONS IN UNIFORM FLOWS,
For primary bibliographic entry see Field 08B.
W70-06393

SPECTRAL ANALYSIS OF DATA GENERATED BY SIMULATION EXPERIMENTS WITH ECONOMETRIC MODELS,
Duke Univ., Durham, N.C.
For primary bibliographic entry see Field 06B.
W70-06416

APPLICATION OF COMPUTER TECHNIQUES TO SEEPAGE-SALINITY SURVEYS IN KANSAS,
Geological Survey, Lawrence, Kans.
R. B. Leonard, and C. O. Morgan.
Kansas Geological Survey Special Distribution Publication 47, 1970. 44 p, 3 tab, 3 ref, 6 append.

Descriptors: *Computer programs, *Data processing, *Water quality, *Seepage, *Saline water, *Kansas, Surveys, Data collections, Hydrologic data, Groundwater movement, Return flow, Water pollution sources, Water chemistry, Digital computers.
Identifiers: Seepage-salinity surveys.

Computer programs designed to calculate and tabulate water quality data used in salinity and seepage surveys are presented. Use of the programs is illustrated by data from nine surveys made in Kansas between April 1964 and October 1968. Low streamflow was measured and samples were collected during each survey at 30 stations in the main stem and near the mouths of tributaries. Successive surveys of the reach were made to reveal progressive changes in the quantity and quality of inflow to the reach that could be attributed to irrigation return flow. The discharge measurements and results of chemical analyses comprise about 5,100 units of basic data. About 37,000 individual calculations, and tabulation of the results in a form that simplifies analysis, were made in about 3 minutes of computer time at a cost of about $50.00. Streamflow in each reach of the main stem consists principally of streamflow entering the upstream end of the reach, tributary inflow, and seepage into or out of the channel. Variations in the quantity and chemical quality of each component, or combination of components, can be evaluated. Measured or calculated output parameters are listed. (Knapp-USGS)
W70-06508

ELECTRONIC COMPUTATION OF WATER LEVELS IN RIVERS DURING HIGH DISCHARGES.
Netherlands Rijkswaterstaat, The Hague.
For primary bibliographic entry see Field 02E.
W70-06546

HYDROLOGICAL ATLAS OF CANADA.
National Research Council of Canada, Ottawa (Ontario).

Canadian National Committee for the International Hydrological Decade, Preliminary Maps, Ottawa, 1969. 6 sheets, 60 graphs, 4 maps.

Descriptors: *Water resources, *Surface waters, *Hydrologic data, *Maps, International Hydrological Decade, Hydrographs, Duration cores, Streamflow, Runoff.
Identifiers: *Canada.

Preliminary maps and graphs of the Hydrological Atlas of Canada include duration curves and maps scaled about 1 inch to 150 miles showing gaging station locations, mean streamflow, mean annual runoff, and mean distribution of runoff. Each map includes all of Canada's territory. The maps result from an initial data compilation in a program associated with the International Hydrological Decade. (Knapp-USGS)
W70-06547

AVAILABILITY OF RAINFALL-RUNOFF DATA FOR PARTLY SEWERED URBAN DRAINAGE CATCHMENTS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 02A.
W70-06573

CONVERSION OF SECTION-TOWNSHIP-RANGE TO LATITUDE-LONGITUDE-A COMPUTER TECHNIQUE,
Montana Coll. of Mineral Science and Technology, Butte.
M. K. Botz.
Available from Montana Bureau of Mines and Geology 203-B, Main Hall, Montana College of Mineral Science and Technology, Butte, Montana. Montana Bureau of Mines and Geology, Special Publication 48, December, 1969. 15 p, 3 tab, 3 fig, 4 ref, append. OWRR Project A-014-MONT (2).

Descriptors: *Computer programs, processing, *Mapping, *Locating, Data st and retrieval, Automation.

A computer technique is described that co township, range, section, and tract location latitude-longitude coordinates. Using an IBM with disk storage drive, the program will cal latitude-longitude coordinates at the rate of 75 points per minute. The average error of th version is about 2.5 seconds of latitude an seconds of longitude, and the maximum er about 7 seconds of latitude and 8 seconds o gitude. The conversion technique is suitab most townships in the western United S Townships that are very irregular are not su for this coordinate conversion program but tension of the logic of this program could be to calculate coordinates in irregular township
W70-06702

A STUDY OF DATA PREPARATION MATHEMATICAL MODELING OF AREA THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. C for Advanced Studies.
For primary bibliographic entry see Field 02F
W70-06706

08. ENGINEERING WORKS

8A. Structures

CALIFORNIA UNDERSEA AQUEI PRERECONNAISSANCE STUDY.
Bureau of Reclamation, Denver, Colo. Offi Assistant Commissioner and Chief Engineer.

Bureau of Reclamation Reconnaissance Stud port, December 1969. 101 p, 3 fig, 510 ref.

Descriptors: *Aqueducts, *Underwater, *Ca nia, Water conveyance, Geology, Hydra Ecology, Oceanography, Hydrodynamics, Water law, Legal aspects, Water demand, benefit analysis, Systems analysis.
Identifiers: California underwater aqueduct.

A preliminary study of the feasibility of a derwater aqueduct to supply water to coastal of California includes investigations of pr water import, alternate sources of water to now used, demand, supply in northern Calif ecology, bathymetry, geology, soils engine ocean hydrodynamics, costs, legal aspects, systems analysis study of the plan. The prer naissance study indicates that a total fund re ment of $2,188,000 and a period of 5-1/2 yea be needed to complete the reconnaissanc vestigation. Based on rough cost esti prepared by National Science Engineering pany, and modified by the Bureau, it is conc that as nearly as can now be determined, it is ble that the cost of water delivered throug aqueduct could be competitive with the c water delivered from other potential sources. ever, many complex engineering and other te cal problems associated with the pot aqueduct are not well understood. (Knapp-US
W70-06366

SAFETY INSPECTION OF HYDRO PROJE FPC ORDER 315,
Federal Power Commission, Fort Worth, Tex. Arthur Martin, Jr.
Pap, Amer Soc Civ Eng, Nat Water Resour Memphis, Tenn, Jan 1970. 8 p.

Descriptors: *Safety, *Inspection, *D Hydroelectric project licensing, Consultin gineers, Earth dams, Concrete dams, Oper and maintenance, Requirements, Dam failure.
Identifiers: *Regulations, Federal Power Cor sion, Engineering evaluation.

ns are being constructed at sites and of heights sidered unthinkable a number of years ago. In- asing numbers of dams, increasing population, past failures and near failures of dams have sed increasing emphasis and concern about the ty of dams. Consequently, the Federal Power nmission, which is responsible for the safety of r 600 dams, issued Order 315 (now Part 12 of FPC regulations) providing for periodic inspec- of dams by independent consultants. The regu- ons require inspection at 5-yr intervals of dams eeding 35 ft in height and dams that form reser- s having a gross storage capacity of more than 0 acre-ft. Inspection of new projects is required in 5 yr after construction. The regulations pro- e for the use of special equipment, instrumenta- , procedures, and inspection staff, and specify er requirements to be covered by the inspec- . Some results of inspections and the ap- aches used by the consultants are described. BR)
0-06372

POSITION AND SCOUR DOWNSTREAM OM SEMIPERMEABLE STRUCTURES,
chnical Univ. of Istanbul (Turkey). Dept. of draulic and Water Power.
zim Cecen, and Mehmetcik Bayazet.
nch resume included. Proceedings 12th Con- ss of International Association for Hydraulic search, Sept 11-14, 1967, Colorado State Univ, t Collins, Vol 2 (Macroturbulence and chastic processes in hydraulics), Paper B22, p 5-193, 1967. 8 p, 6 fig, 2 ref.

scriptors: *Dams, *Dam construction, *Sedi- ntation, *Dam design, *Deposition (Sedi- nts), Scour, Sediment transport, Sediment load, del studies, Bed load, Hydraulic models, Turbu- ce, Earth dams, Hydraulic-fill dams.
ntifiers: Semipermeable dams.

ans of constructing small dams on rivers at a low t by depositing the sediment load of the stream ng semipermeable structures were investigated. evious studies showed that some types of screens uld be used for this purpose. Experiments were de with various types of structures, different perties of flow and sediment, to determine the t type to use in natural streams. Owing to the ndance of parameters, a series of initial runs re made to determine the proper types of struc- es. It was found that a structure consisting of rallel fine screens gave good results. Such a ucture that causes a sill to be built downstream a result of reduction of macroturbulence was ed with various flow conditions and sediments. e influences of slope of screens, distance tween them and their height were determined. o types of sediment were used in these experi- nts: uniform sand, and tuff that has a graded size tribution. This made it possible to compare the ects of size distribution. Evolved type of struc- e can be built on natural streams using fence e, etc. The sill to be deposited below such a stru- re can be stabilized and used as a small dam. our that would occur downstream can also be evented at a low cost by using parallel screens. napp-USGS)
70-06385

DAM ACROSS THE AMAZON,
dson Inst., Inc., Croton-on-Hudson, N.Y.
r primary bibliographic entry see Field 04A.
70-06538

3. Hydraulics

MILARITY IN UNLINED IRRIGATION NAL SYSTEMS,
uthampton Univ. (England). DEPT. OF Civil gineering.
nneth V. H. Smith.
CE Proceedings, Journal of the Hydraulics Divi- n, Vol 96, No HY 1, Paper 6993, p 13-28, nuary 1970. 16 p, 11 fig, 3 tab, 14 ref, append.

Descriptors: *Open channel flow, *Canals, *Alluvial channels, *Channel morphology, *Hydraulic similitude, Hydraulics, Irrigation canals, Regime, Dunes, Ripple marks, Roughness (Hydraulic), Sediment transport, Particle size.
Identifiers: Unlined canals.

Data from three irrigation canal systems are examined, and the observed variations in some relevant flow parameters are considered in relation to the conditions which apply in the case of completely similar movable bed channel flows. It can be seen that the canals flow with ripple, dune, or transitional bed regimes, and that the bed material size decreases in a downstream direction in such a way that the ratio of the mean velocity of flow to the fall velocity of the bed material tends to remain constant. It is shown that it is impossible for complete similarity to exist between the flows in real alluvial channels, and accordingly an attempt is made to define conditions of quasi-similarity based on the stage of development of the bed formation. (Knapp-USGS)
W70-06333

TURBULENCE IN THE MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Joseph B. Tiffany.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ. Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B41, p 349-355, 1967. 7 p, 4 fig.

Descriptors: *Turbulence, *Mississippi River, *Scour, Hydraulics, Vortices, Eddies, Instrumentation, Flow measurement, Flowmeters, Current meters, Water measurement, Turbulent flow, Floods, Streamflow.
Identifiers: Macroturbulence, Turbulence meters.

Turbulence in the Mississippi River is of particular interest because of its effects on revetment used to stabilize the erodible banks of the river. Velocity fluctuation measurements indicated an approximate 20-minute cycle with a superimposed cycle averaging about 3 minutes. Since most standard discharge measurements include a 5-minute observation at a given point in a vertical, considerable deviation from the long-time true average velocity could result. The turbulence patterns had spatial dimensions at least of the order of the depth of the river at the point of observation. A hydrodynamic pulsimeter consisting of a cast-iron disk with a pressure cell set in its surface and a current meter suspended above the surface was developed. During the 1950 flood, velocity measurements at 42 points in depths to 100 feet ranged from 2 to 15 feet per second. Differences in pressure of as much as 0.5 pounds per square inch occurred in about 15 to 30 seconds, and deviations from the average velocity of as much as 4 to 6 feet per second occurred in very short time intervals. Uplift pressures in the Mississippi River are capable of lifting concrete slabs as thick as 6 inches from the river bottom. (Knapp-USGS)
W70-06382

SOME CHARACTERISTICS OF MACRO-TURBULENCE IN FLOW PAST A NORMAL WALL,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Frederick A. Locher, and Eduard Naudascher.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2, (Macroturbulence and stochastic processes in hydraulics), Paper B35, p 298-307, 1967. 10 p, 7 fig, 9 ref.

Descriptors: *Turbulent flow, *Open channel flow, *Vortices, *Turbulence, Cavitation, Aeration, Flow separation Hydraulic structures, Pressure, Scour, Hydraulics, Open channels.
Identifiers: Macroturbulence, Secondary currents.

Abrupt changes in boundary form are the rule rather than the exception in much of Civil Engineering design. The normal wall of finite thickness placed on a boundary is among the geometric configurations often encountered in hydraulic structures, as in gated outlet works. An extensive investigation of the pressure fluctuations in the vicinity of such a wall has been undertaken to obtain a better understanding of the mechanism by which structural vibrations are induced. The results presented herein include the spectral distribution and RMS values of the pressure fluctuations near a stationary wall as affected by the relative wall thickness and cavitation. A dominant frequency is shown to be associated with an unstable flow reattachment near the downstream edge of the wall and with the unsteadiness of the overall extent of the separation zone. Cavitation is found to increase both the periodicity and the amplitude of the pressure fluctuations. (Knapp-USGS)
W70-06383

THE TURBULENT STRUCTURE OF OPEN RESTRICTED DEPTH FLOW WITH INTERFACE,
Akademiya Nauk URSR, Kiev.
N. G. Pozniaja.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B36, p 308-314, 1967. 7 p, 2 fig, 3 ref.

Descriptors: *Turbulent flow, *Stratified flow, *Vortices, *Open channel flow, *Stratification, Interfaces, Boundary processes, Jets, Model studies, Hydraulic structures, Pressure, Hydraulics, Open channels.
Identifiers: Macroturbulence.

The macroturbulence caused by the interface between the transit flow and lateral roller in abrupt two-dimensional flow expansion is studied experimentally for determination of vortex zone resistance to transit jet motion. It has been established that the sign change of correlation moment between longitudinal and vertical fluctuations for the depth is the characteristic feature of the turbulent structure on the interface. The analysis of mean motion energy balance equation proves that the change of signs is caused by hightened resistance induced by vortexes with a vertical core in the boundary zone near the flow surface. This resistance is very important in calculation of two-dimensional flow expansion behind the hydraulic structures. (Knapp-USGS)
W70-06384

A COMPUTATIONAL INVESTIGATION OF IMPULSIVELY-GENERATED EDDIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Tin-Kan Hung.
French summary included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B37, p 315-322, 1967. 8 p, 2 fig, 6 ref.

Descriptors: *Turbulent flow, *Eddies, *Vortices, *Flow separation, *Unsteady flow, Energy dissipation, Mathematical studies, Cavitation, Hydraulics, Open channels, Open channel flow.
Identifiers: Macroturbulence.

The eddy formation accompanying an impulsive acceleration of an incompressible fluid through a two-dimensional symmetric conduit expansion is computed from the basic equations of motion by using a finite-difference scheme. The primary transient characteristics of such an impulsively-generated eddy are its large vorticity and high rate of energy dissipation. The calculated results are presented as contours of constant values of the stream function, vorticity, viscous stresses, and Bernoulli-sum. The distribution of each of the sig-

nificant physical quantities in the work-energy equation in the zone of separation is shown in the vicinity of the expansion. (Knapp-USGS)
W70-06386

MACRO-TURBULENCE MEASUREMENTS IN NATURAL STREAMS,
Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics.
For primary bibliographic entry see Field 02E.
W70-06387

THE EFFECT OF AXIAL VELOCITY FLUCTUATIONS ON THE RESPONSE OF A HELICAL FLOW METER,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Erich J. Plate.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ. Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B33, p 281-289, 1967. 9 p, 3 fig, 1 tab, 7 ref.

Descriptors: *Flowmeters, *Turbulent flow, *Calibrations, Laboratory tests, Current meters, Flow measurement, Turbulence, Instrumentation, Water measurement.
Identifiers: *Turbulence effects (Flowmeters), Helical flowmeters.

The work of Grey and Jepson on the response of a helical flowmeter to a step velocity input is extended to the case of a sinusoidally varying axial velocity fluctuation superimposed on a mean velocity. The dynamic equation is derived and solved for small amplitude fluctuations. The meter should over-register if axial turbulence is present by an amount which, to a first approximation, is proportional to the square of the ratio of the amplitude of the sinusoidal velocity to the mean velocity. The result is compared with data of Fischer. Qualitative agreement is found, but the experimental data do not contain enough information for evaluating all the parameters which appear in the solution. (Knapp-USGS)
W70-06388

TURBULENCE MEASUREMENT BY MEANS OF SMALL CURRENT METER IN FREE SURFACE FLOW,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W70-06389

EXPERIENCE WITH TURBULENCE METERS AND THEIR IMPROVEMENT,
Technische Hochschule, Munich (West Germany). Hydraulics Research Station Obernach.
For primary bibliographic entry see Field 07B.
W70-06390

MEASUREMENT METHODS OF MACROTURBULENCE,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
For primary bibliographic entry see Field 07B.
W70-06391

POTENTIAL FLUCTUATIONS GENERATED BY TURBULENCE ON A SMALL WIRE,
Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
For primary bibliographic entry see Field 07B.
W70-06392

CALCULATION OF SPECTRA OF TURBULENT PULSATIONS IN UNIFORM FLOWS,
V. M. Ljatkher.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B3, p 17-35, 1967. 19 p, 4 fig, 11 ref.

Descriptors: *Turbulent flow, *Mathematical studies, Vortices, Open channel flow, Closed conduit flow, Boundary processes, Viscosity, Shear drag.
Identifiers: Spectral analysis.

The turbulent spectra of velocity and pressure pulsations in uniform flows (inside the flow core and in viscous sublimation on the flow boundary) are calculated on the base of viscous fluid motion equations given in the Helmholtz form and linearized against velocity pulsation components. The qualitative difference of pulsation spectra in free surface flow and flow under pressure is discussed. Calculation and experimental results are compared. They confirm the need for further development of the proposed method. (Knapp-USGS)
W70-06393

LARGE EDDIES IN STRATIFIED FLOW,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
Mikio Hino, Hiroshi Shikata, and Mayuki Nakai.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B8, p 61-73, 1967. 13 p, 10 fig, 27 ref.

Descriptors: *Turbulence, *Vortices, *Stratified flow, *Open channel flow, Model studies, Hydraulic models, Mixing, Interfaces, Stratification.
Identifiers: *Macroturbulence, Longitudinal vortices.

By the application of 'hydrogen bubble' technique of flow visualization the stability and formation of large eddies and turbulence are measured in both homogeneous and stratified flows. There has been observed a marked difference between the two flows, particularly the suppression of transition from laminar to turbulence, the reduced intensity of longitudinal vortices, and the decrease in the Karman constant for stratified flow. Additional experiments on the generation of the Karman vortex in both flows are discussed. The same technique is also applied to study the interfacial structure of two-layered flows. (Knapp-USGS)
W70-06394

DYANMIC HYDROLOGY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-06522

EFFECT OF A STABILIZING GRADIENT OF SOLUTE ON THERMAL CONVECTION,
Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 05B.
W70-06641

THE UNSTABLE THERMAL INTERFACE,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
J. W. Elder.
Journal of Fluid Mechanics, Vol 32, Part 1, 1968, p 69-96. 21 fig, 23 ref.

Descriptors: *Thermal stratification, *Turbulence, Porous media, Viscous flow.
Identifiers: *Thermal turbulence.

This study investigates the motion which develops in a deep layer of a viscous, thermally conducting fluid initially hot below and cold above some horizontal plane, so that the system is gravitationally unstable, by laboratory and numerical e
periments. Three cases are considered: (1) the flo
which occurs in a porous medium when the inte
face is the lower boundary of the system; (2)
similar study in a viscous fluid; (3) an interfa
distant from the confining horizontal boundaries,
a viscous fluid. In all cases the initial developme
of the flow occurs within the thermal interfa
between the hot and cold fluid. The developme
of the disturbances in the interface involves:
period in which the diffusion of heat and vortici
dominate; a period involving rapid amplificati
with diminishing importance of the role of diffusi
of heat; a period of emergence of the disturbanc
from the interface, during which the acceleratio
are sufficiently rapid for molecular processes to
unimportant, entrainment being the domina
process; and finally a period of adjustment of t
large eddies. The amplification process
adequately described by the linearized equations
motion. (Guerrero-Vanderbilt)
W70-06643

**THE THERMOHALINE RAYLEIGH-JEFFRE
PROBLEM,**
Auckland Univ. (New Zealand). Dept. of Math
matics.
For primary bibliographic entry see Field 05B.
W70-06644

**THE INFLUENCE OF MOLECULAR DI
FUSIVITY ON TURBULENT ENTRAINMEN
ACROSS A DENSITY INTERFACE,**
Cambridge Univ. (England). Dept. of Appli
Mathematics and Theoretical Physics.
J. S. Turner.
Journal of Fluid Mechanics, Vol 33, Part 4, 1968
639-656. 6 fig, 12 ref.

Descriptors: *Density stratification, *Therm
stratification, *Interface, *Mixing.
Identifiers: *Richardson number, *Entrainment.

The rate of mixing across a density interfa
between two layers of liquid has been measured
a laboratory experiment which allows a direct co
parison between heat and salinity transports ov
the same range of density differences. L
Reynolds number turbulence was produced by st
ring mechanically at a fixed distance from the int
face. For density differences produced by h
alone, the functional dependence is close to R
except at small values of Ri where it approache
finite limit. For experiments with a salinity d
ference across the interface, the mixing rate is
same as in the heat experiments at low values of
but falls progressively below this as Ri is increas
with the approximate form Ri-3/2. An interpre
tion of these results has been attempted, using
dimensional analysis and qualitative mechanis
arguments about the nature of the motion. T
decreased mixing rates for salt have been attribut
to a slower rate of incorporation of an entrain
element into its surroundings by diffusion, whi
increases the tendency for it to return to the int
face and dissipate energy in wave-like motio
(Guerrero-Vanderbilt)
W70-06646

**A NOTE ON THE STEADY TWO-DIME
SIONAL FLOW OF A STRATIFIED FLU
OVER AN OBSTACLE,**
Melbourne Univ., Parkeville (Australia). Dept.
Mathematics.
R. Grimshaw.
Journal of Fluid Mechanics, Vol 33, Part 2, 1968
293-301. 15 ref.

Descriptors: *Stratified flow, *Froude numb
Open channel flow, Fluid mechanics.
Identifiers: *Wave equation.

A study was conducted of the steady two-dim
sional flow of an inviscid incompressible fluid
variable density in a long channel, bounded abo
by a rigid horizontal plane and below by an obs

. For certain variations with height of the speed
l density in the incident stream, the governing
ıation is the reduced wave equation. Drazin and
ore (1967) have used this fact to develop a
ve-guide analogy. The wave-guide analogy is
ther developed and several uniqueness theorems
ained. When the obstacle satisfies a certain con-
ity condition it was shown that the upstream
ıditions and the obstacle uniquely determine the
w; that is, there is no critical internal Froude
mber or obstacle height for which the problem
s to be well posed. (Guerrero-Vanderbilt)
70-06647

E STABILITY OF A STRATIFIED FLUID,
ınash Univ., Clayton (Australia). Dept. of
chanical Engineering.
3. Hinwood.
ırnal of Fluid Mechanics, Vol 29, Part 2, 1967, p
3-240. 8 fig, 3 ref.

scriptors: *Stratified flow, *Interface, *Model
dies, *Stability, Fluid mechanics.

is study investigated the stability of the interface
tween two liquid strata of equal depth and
charge for the case of no relative motion
tween the strata. Hence the presence of viscous
ar at the interface is no longer the primary cause
instability. This study was concerned with two
scible strata with a very small difference in densi-
The experiments were performed in a rectangu-
conduit of black lucite, 6 in. wide, 2 in. deep
d 130 in. long, connected to a large stationary
ad tank at the upstream end, and a flow meter
d a small moveable overflow tank at the
wnstream end. It was maintained at constant
charge through the unit. Some conclusions were:
) A stably stratified flow with no interfacial shear
sometimes less stable than an unstratified flow,
spite the stabilizing influence of gravitational
rces. (b) The upper and lower critical Reynolds
mbers are functions of the interfacial Froude
mber F, and that if F is large they are lower than
r a homogeneous flow. (c) In stratified flows the
sturbances leading to turbulent flow sometimes
ise at the interface and lead to interfacial waves,
ıose wavelength at breaking is equal to the con-
it depth. (Guerrero-Vanderbilt)
70-06648

HE STABILITY OF THERMALLY
RATIFIED PLANE POISEUILLE FLOW,
ıicago Univ., Ill.
S. Gage, and W. H. Reid.
urnal of Fluid Mechanics, Vol 33, Part 1, 1968, p
-32. 4 fig, 13 ref, 2 tab.

escriptors: *Stratified flow, *Stratification, *Sta-
lity, Flow, Thermal stratification.
entifiers: *Richardson number, *Prandtl number.

ıis study investigates the stability of a thermally
ratified fluid in the presence of a viscous shear
ow, in the situation in which there is an important
teraction between the mechanism of instability
ıe to the stratification and the Tollmien-Schlicht-
g mechanism due to the shear. A complete analy-
s had been carried out for the Benard problem in
e presence of a plane Poiseuille flow and it is
own that, although Squire's transformation can
e used to reduce the three-dimensional problem
an equivalent two-dimensional one, a theorem of
ıuire's type does not follow unless the Richardson
ımber exceeds a certain small negative value.
ıis conclusion follows from the fact that, when
e stratification is unstable and the Prandtl
ımber is unity, the equivalent two-dimensional
oblem becomes identical mathematically to the
ability problem for spiral flow between rotating
linders. To obtain a quantitative comparison
tween theoretical and observed results, it will be
early necessary to consider the stability of
ratified shear flows for more general classes of
mperature and velocity profiles. (Guerrero-Van-
rbilt)
70-06651

REDUCTION OF RIVER HEAT POLLUTION BY TURBULENCE STIMULATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 05D.
W70-06704

8C. Hydraulic Machinery

REDUCTION OF NOISE AND VIBRATIONS IN A HYDRAULIC TURBINE,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
T. Sagawa.
Trans Amer Soc Mech Eng, Vol 91, Ser D, No 4, p 722-727, Dec 1969.

Descriptors: *Hydraulic turbines, *Noise, *Vibrations, Pressure, Flow, Turbine blades, Turbine runners, Francis turbines, Hydraulic machinery, Investigations, Guide vanes, Field tests, Velocity, Vortices.
Identifiers: *Foreign testing, Japan, Test results, Pressure waves.

Test procedures used to isolate and reduce abnormal noise and vibration in hydraulic turbines are described. During a period of 1-1/2 yr, the noise level, vibrations, and pressures were measured in various operating conditions of 2 turbines in a Japanese powerplant, and various corrective methods were investigated. Separated flows entering a turbine have a small random pressure fluctuation producing a singular frequency, which, if near the natural frequency of the runner blades, can cause severe vibrations in the runner. Modifying the runner blading eliminated the noise and vibrations. (USBR)
W70-06367

ADDITIONS TO CHIEF JOSEPH DAM POWER PROJECT,
Corps of Engineers, Seattle, Wash.
A. Lee Warbington.
Pap, Amer Soc Civ Eng, Nat Water Resources Eng Meet, Memphis, Tenn, Jan 1970. 38 p, 8 fig, 16 tab.

Descriptors: *Hydroelectric plants, Hydroelectric power, Enlargements (Structures), Project benefits, Project feasibility, Project planning, Comparative benefits, Generators, *Power head, Powerhouses, Cost-benefit analysis, Future planning (Projected), Peaking capacities, Peak power, *Design criteria, Concrete dams, Cost comparisons.
Identifiers: *Chief Joseph Dam Proj (Wash), Comparative studies, Design assumptions, Changed conditions, Grand Coulee Powerplant (Wash).

Studies to determine the rated head for 11 additional generating units scheduled for installation at Chief Joseph Dam Project on the Columbia River in Washington are presented. Planning and design studies for the present facility and changed conditions since the initial construction are discussed. Several possible schemes for future expansion beyond the 11 scheduled units were considered because of their effect on the rated head for the scheduled units. Large potential net power benefits could be gained by raising the pool elevation and adding additional units at a later date. Powerhouse extension is physically and economically feasible, and the pool elevation can be raised by modifying the dam, spillway, and powerhouse. If additional units are added, the optimum pool elevation would be 24 ft above the present pool elevation. To allow for full utilization of additional head prompted by future additional units, design head for the scheduled 11 units should be based on a 24-ft rise in pool elevation. Benefit-cost data are presented. Effects of an increased pool elevation at Chief Joseph Dam on power production at Grand Coulee Dam, located 51 mi upstream, are discussed. (USBR)
W70-06373

ESTIMATING THE SWITCHING SURGE PERFORMANCE OF TRANSMISSION LINES,
Westinghouse Electric Corp., East Pittsburgh, Pa.
A. R. Hileman, P. R. Leblance, and G. W. Brown.
Trans Pap 70 TP 38-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1970. 15 p, 26 fig, 2 tab, 9 ref, 2 append.

Descriptors: *Transmission lines, *Extra high voltage, Estimating, *Probability, Circuit breakers, Resistors, Investigations, Histograms, Polarity, Electric insulation, Electric currents, Test facilities, Theory, Calculations, Faults (Electrical), Electrical design.
Identifiers: *Switching surges, *Flashover, Overvoltage Test results, Electric discharges, *Ultra high voltage.

A simplified method of estimating the switching surge flashover probability of a transmission line is developed and presented in a series of curves. Any simplified method requires making 2 obvious assumptions: (1) the frequency of occurrence of switching surge voltages, and (2) the probability of flashover of tower insulation as a function of voltage. A miniature system study on a 125-mi, 1100-kv transmission line was performed to investigate the probability distribution and the validity of the 2 assumptions. Results were used to produce sets of curves from which estimates of the switching surge flashover probability can be determined. The miniature system study is discussed, and a schematic of the 1100-kv study circuit is shown. Histograms of absolute peak voltages and switching surge flashover probability curves are included. (USBR)
W70-06375

A TRANSFORMER CORONA TEST ON SWITCHING OVERVOLTAGES,
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
L. C. Aicher.
Conf Pap 70 CP 121 - PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1970. 5 p, 1 fig, 7 ref.

Descriptors: *Power transformers, Dielectrics, *Electrical coronas, Radio interference, *Test procedures, *Electric insulation, Lightning arresters, Performance tests, Instrumentation, Deterioration.
Identifiers: *Electric discharges, *Switching surges, *Overvoltage, Dielectric breakdown, Insulating oil, Flashover, Test results.

Power transformer dielectric requirements have been modified to meet operating conditions more adequately or economically. New dielectric tests have been developed to demonstrate that the qualities necessary to fulfill requirements have been provided. Among the tests applied to a growing number of high-voltage power transformers is one referred to as radio noise, radio influence voltage, corona, or partial discharge. A test method is presented that will alleviate growing concern of the integrity of reduced BIL transformers, with respect to corona. The transformer would be subject to a partial discharge test at a voltage level related to the maximum voltages that will be experienced in service. The proposed test voltage is related to the low frequency equivalent of the maximum switching surge voltage that the protective lightning arrester will permit on the transformer. Being essentially free of partial discharges, as determined with appropriately sensitive instrumentation, ensures that the transformer has the corona characteristic conducive to long life. (USBR)
W70-06376

CONTROLLING SWITCHING SURGES ON 1100-KV TRANSMISSION SYSTEMS,
Westinghouse Electric Corp., East Pittsburgh, Pa.
J. K. Dillard, J. M. Clayton, and L. A. Kilar.
Trans Pap 70 TP 76-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1970. 11 p, 8 fig, 6 tab, 9 ref.

Descriptors: *Transmission lines, *Electric insulation, Extra high voltage, Circuit breakers, Resistors, Investigations, Analog computers, Theory, Faults (Electrical), Calculations, *Electrical design, Lightning arresters, Dielectrics, Feasibility, Economics.
Identifiers: *Ultra high voltage, *Switching surges, *Overvoltage, Flashover, Test results, Electric discharges, Shunt resistors.

One great technical challenge facing ultra high voltage transmission is effectively contolling transient overvoltages caused by switching transmission lines. At high operating voltages, uncontrolled switching surges pose the greatest stress on system insulation and consequently dictate insulation levels throughout the system. A study was made using an analog computer to evaluate the technical feasibility of various alternatives for limiting switching surges on future 1100-kv transmission systems. Various alternatives for limiting switching surges, including controlled and uncontrolled, multistep resistor breakers, were investigated under different system conditions. Several alternatives were capable of limiting surge magnitudes to acceptable values. A description of the system used, the effects of system parameters, and results of the study are given. (USBR)
W70-06378

FULLY WATER-COOLED 190 MVA GENERATORS IN THE TONSTAD HYDROELECTRIC POWER STATION,
Bown, Boveri and Co. Ltd., Baden (Switzerland).
E. Ostby, and K. Gamlesaeter.
Brown Boveri Rev, Vol 56, No 8, p 380-385, Aug 1969. 6 p, 8 fig, 1 tab, 1 ref.

Descriptors: Hydroelectric power, *Electric generators, Losses, *Water cooling, *Stators, *Rotors, Electrical design, Deaeration, Stress, Fresh water, Thermal stress, Foreign design practices.
Identifiers: Norway, Deionization, *Machine design, Service life.

Design features of 2 fully water-cooled 190 mva hydroelectric generators in service for about one year at the Tonstad plant in Norway are described. The stator and rotor windings are cooled by a closed-circuit system containing deionized and deaerated water. Stator laminations and pressure plates are cooled by ordinary fresh water. Advantages of direct water-cooling are enumerated. Operation of these machines has been satisfactory, and experience gained forms an important base for further development of fully water-cooled generators. (USBR)
W70-06379

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 05G.
W70-06406

ECONOMIC ASPECTS OF HYDRO POWER,
Water Power Inc., London (England).
For primary bibliographic entry see Field 06C.
W70-06407

SEWAGE PLANT DESIGNED FOR FLUCTUATING POPULATION,
Nebolsine, Toth and McKee, Fort Lee, N.J.
For primary bibliographic entry see Field 05D.
W70-06587

8D. Soil Mechanics

STATE-OF-THE-ART SURVEY SOIL STABILIZATION, VOLUME I,
Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.
Hans F. Winterborn.
Available from the Clearinghouse as AD-846 786, $3.00 in paper copy, $0.65 in microfiche. Distribution limitation now removed. Engineering Dept. Report No. NAEC-ENG-7469, Vol I. Phila., Penn. Dec. 13, 1968, 107 p.

Descriptors: *Soil stabilization, Soil properties, Soil types, Clays, Sands, *Soil sealants, Electro-osmosis.
Identifiers: *Stabilized soil systems.

An extensive state-of-the-art survey on methods of soil stabilization has been conducted, with the aim of compiling an authoritative and convenient source of reference. In volume I of this report, the nature of soil stabilization as a progressing science is discussed, and eight methods are presented in detail. Volume II will provide a reliable guide as to which of the abundant methods should be used for a given task under specific conditions.
W70-06463

8E. Rock Mechanics and Geology

ROCK MOVEMENT AND SUBSEQUENT STABILIZATION - MORROW POINT UNDERGROUND POWERPLANT,
Bureau of Reclamation, Denver, Colo.
Gilbert L. Brown, Ernest D. Morgan, and Jerry S. Dodd.
Pap Amer Soc Civ Eng Nat Meet Water Resour, Memphis, Tenn, Jan 1970. 66 p, 28 fig, 1 tab, 6 ref, append.

Descriptors: Hydroelectric power, *Electric generators, Losses, *Water cooling, *Rotors, Electrical design, Deaeration, Stress, Fresh water, Thermal stress, Foreign design practices.
Identifiers: Norway, Deionization, *Machine design, Service life.

During excavation of the underground Morrow Point Powerplant in Colorado, an extensive rock monitoring system detected inward movement along a longitudinal rock face of the powerplant chamber. The movement was associated with a large rock polyhedron formed in part by 2 intersecting faults and the powerplant rock wall. Investigations indicated that further movement was possible, necessitating installation of a permanent restraint system. Geology of the damsite and powerplant area, preconstruction rock stability analysis, instrumentation, rock movement, analysis to evaluate rock movement, and measures to stop the movement are described. Anchor bars, long rock bolts, poststressed tendons, and flat jacks were selected to provide the required support. The restraint system, designed out of necessity by intuitive engineering judgement, proved to be properly designed on the basis of an improved method of rock mechanics analysis. (USBR)
W70-06381

THE BIRTH AND DEVELOPMENT OF THE CONCEPT OF DIAGENESIS,
Strasbourg Univ. (France). Inst. of Geology.
For primary bibliographic entry see Field 10.
W70-06398

8G. Materials

HVDC EFFECTS ON PIPE LINES,
Cornell, Howland, Hayes and Merryfield, Corvallis, Oreg.
Thomas B. Hayes, George H. Silkworth, and Robert D. Schilling.
Pipe Line Ind, Vol 32, No 2, p 27-30, 54, Feb 1970. 5 p, 8 fig.

Descriptors: *Pipelines, *Corrosion, *Extra high voltage, Transmission (Electrical), Coatings, *Direct current, Electric fields, Electrical properties, Electrical potential, Electrodes, Corrosion control, Cathodic protection, Electrical grounding, Polarity, *Electric currents.
Identifiers: *Ground currents, *Stray current co
rosion, Buried pipes, Corrosion currents, Grou
return, Earth resistivity (Elect).

A pipeline collects, conducts, and discharges ele
tric current of high-voltage, direct-current (hvd
origin as a result of the electric field established
the d-c current transmitted through the earth, a
by the electrical properties of the pipelin
Methods used to calculate quantitative chara
teristics of the earth's gradient and hvdc effects
pipelines are given. Requirements for protecti
along the pipeline from corrosion or disbonding a
developed and results are given. The upper limit
protection is the maximum amount of current th
can be collected by the pipeline without exceedi
the disbonding limit. The lower limit of protecti
is the minimum amount of current that can be c
lected by the pipeline to keep it above the cor
sion limit. (USBR)
W70-06377

**MATERIALS OF CONSTRUCTION FO
TRADE WASTE TREATMENT PLANTS,**
Prodorite Ltd., Birmingham (England).
D. V. Paradington.
Water Pollution C ol, London, Vol 67, No
1968. p 269-275, , 2 ref.

Descriptors: *Construction materials, *Corrosio
*Costs, Reliability, Pumps, *Waste treatme
Waste water treatment.
Identifiers: *Trade waste, *Treatment plant, *C
rosive liquors, *Chemical resistance, Plant desig
Contaminants, Pipe work.

A general background is presented relating to
difficulties confronting the plant designer wh
selecting the materials of construction for a tra
waste treatment plant. Particular emphasis is giv
to the construction of tanks. Construction mate
als should have chemical-resisting capacity. Atte
tion should be paid to such factors as the risk
mechanical damage and thermal conditions. Sele
tion of materials for pumps should be consult
with pump manufacturers. The need is emphasiz
for plastic pipes. The chemical resistance of a
construction material depends upon the individu
contaminants present, and therefore it can be da
gerous to generalize any point. For this reason fi
selection of material should be left to the specia
engineer. While great reliance is placed on conve
tional techniques, the use of synthetic material
assuming an ever increasing importance. (Shank
Texas)
W70-06586

8H. Rapid Excavation

**GEOHYDROLOGY - PROJECT RULISO
GARFIELD COUNTY, COLORADO,**
Geological Survey, Denver, Colo.
P. T. Voegeli, Sr., S. W. West, and E. H. Cordes.
Geological Survey Open-file report, March 19
52 p, 11 fig, 12 tab, 7 ref. USAEC Contract No
(29-2)-474. Rulison-5 Project.

Descriptors: *Hydrogeology, *Colorado, *Nucl
explosions, *Aquifers, Water levels, Water yie
Water pollution sources, Path of pollutan
Groundwater movement, Nuclear engineeri
Nuclear wastes, Oil fields, Water wells, Permeab
ty, Monitoring.
Identifiers: Gas fields, Project Rulison.

The Project Rulison nuclear experiment
detonated at a depth of 8,425 ft below ground le
at the Rulison site in Garfield County, Colora
September 10, 1969. The experiment was desig
to stimulate natural gas production from a g
bearing formation of low permeability. All zo
below a depth of 6,129 ft in the Rulison explorat
hole that yielded any water during drilling, or zo
interpreted from geophysical logs as being likel
contain water, were hydraulically tested. The p
sures recorded during the drill-stem tests of the
ferent zones indicated negligible or no fluid en

he hole. No fluid was recovered on any of the
b tests performed during the drill-stem tests.
dies of preshot and postshot hydrologic condi-
s indicate that the detonation did not signifi-
tly or permanently affect wells, springs, streams
llow aquifers, or reservoirs in or near the Ru-
n site. (Knapp-USGS)
0-06517

. MANPOWER, GRANTS AND FACILITIES

. Education (Extramural)

TER FOR ARKANSAS,
ological Survey, Little Rock, Ark.
. Sniegocki, and M. S. Bedinger.
ological Survey Cooperative Report, 1969. 46 p,
fig, 2 tab, 10 ref.

scriptors: *Water resources, *Arkansas, *Social
ects, Schools (Education), Hydrogeology,
uifer characteristics, Runoff, Geohydrologic
ts, Water quality, Water utilization, Streamflow,
ter management (Applied), Public benefits,
servoirs, Inter-agency cooperation.
ntifiers: Water knowledge (General).

present Arkansas' water resources in a plain and
eresting manner for the layman and for school
ldren, this well-illustrated book was prepared
m facts drawn from many published and un-
blished reports and from suggestions and infor-
tion given by the authors' associates in the U.S.
ological Survey. It avoids highly technical mat-
s and yet gives much scientific information in an
sy-to-understand manner. The book answers
ch questions about water as where it is, how good
it, how much is there, and how do we develop
d manage it in accordance with the realities of
ture. Block diagrams, maps, graphs, and photo-
aphs (many in color) are used extensively to
ow the geology, aquifer systems, range in well
elds by aquifers, river systems, chemical quality
the different waters (streamflow and ground-
ter), depth to salt water, water temperatures, ru-
ff by major river basins, large reservoirs, and
ter use in Arkansas by decades since 1900. A
ng range course of action is given stressing need
r appraisal studies and the use of resulting facts in
velopment of water plans and water management
licies. A list of State and Federal agencies in-
volved in Arkansas water resources is presented with their areas of competence and interest. (Lang-USGS)
W70-06576

9B. Education (In-House)

FINANCING WATER UTILITY TRAINING,
Mahoning Valley Sanitation District, Youngstown, Ohio.
For primary bibliographic entry see Field 06B.
W70-06414

OPERATOR TRAINING BY AN IN-PLANT APPRENTICESHIP PROGRAM,
Orange County Sanitation Districts, Fountain Valley, Calif.
For primary bibliographic entry see Field 05D.
W70-06626

9D. Grants, Contracts, and Research Act Allotments

GROUNDWATER RESEARCH IN THE U.S.A.,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 06B.
W70-06402

10. SCIENTIFIC AND TECHNICAL INFORMATION

THE BIRTH AND DEVELOPMENT OF THE CONCEPT OF DIAGENESIS,
Strasbourg Univ. (France). Inst. of Geology.
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Descriptors: *Diagenesis, *Reviews, *Bibliographies, Sedimentation, Water chemistry, Sedimentology, Groundwater movement, Clay minerals, Mineralogy.

The literature of diagenesis is surveyed and a selected bibliography is presented. The great number of researchers who are at present interested in diagenesis, and the increasing bibliographic exchanges between east and west have made necessary a detailed examination of the concept. Without a critical knowledge of the facts hidden behind the words, misunderstandings, if not quarrels, will soon make conversation between specialists difficult. In this article critical analysis is attempted without proposing any new system. (Knapp-USGS)
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STATE-OF-THE-ART SURVEY SOIL STABILIZATION, VOLUME I,
Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.
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For primary bibliographic entry see Field 02K.
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Cornell University - Policy Models for Water Resources Systems	W70 06684--06690 06698--06701	11
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Connecticut Institute of Water Resources	W70 06704	1
C. Other		
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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 17
SEPTEMBER 1, 1970

W70-06732 -- W70-07148

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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02 WATER CYCLE
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01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

DIFFUSION COEFFICIENT OF SODIUM NITRATE IN AQUEOUS SOLUTION AT 25 DEG C AS A FUNCTION OF CONCENTRATION FROM 0.1 to 1.0M,
Virginia Polytechnic Inst., Blacksburg. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 02K.
W70-06994

02. WATER CYCLE

2A. General

THE KINEMATIC CASCADE AS A HYDROLOGIC MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
David F. Kibler, and David A. Woolhiser.
Available from the Clearinghouse as PB-191 816, $3.00 in paper copy, $0.65 in microfiche. Colorado State University Hydrology No 39, March 1970. 27 p, 21 fig, 4 tab, 18 ref, 3 append. OWRR Project B-030-Colo (2).

Descriptors: *Overland flow, *Rainfall-runoff relationships, *Mathematical models, Model studies, Roughness (Hydraulic), Streamflow forecasting, Runoff forecasting, Open channel flow.
Identifiers: Kinematic wave theory, Kinematic cascade model, Watershed models.

A kinematic cascade is defined as a sequence of discrete overland flow planes or channel segments in which the kinematic wave equations are used to describe the unsteady flow. Each plane or channel is characterized by a length, width, and a roughness-slope factor. Outflow from the K-th plane, along with the parameters for planes k and k +1, establishes the upstream boundary condition for plane k +1. Nondimensional equations are presented for the K-th element in a kinematic cascade. Properties of the solutions for a kinematic cascade with pulsed lateral inputs are examined. Cascade solutions are compared with characteristic-analytic solutions and with experimental data for flow over a linearly converging section. (Knapp-USGS)
W70-06843

RUNOFF FROM WATERSHED MODELS,
State Univ. of New York, Syracuse. Coll. of Forestry.
Peter E. Black.
Water Resources Research, Vol 6, No 2, p 465-477, April 1970. 13 p, 8 fig, 1 tab, 35 ref.

Descriptors: *Rainfall-runoff relationships, *Hydraulic models, *Hydraulic similitude, *Simulated rainfall, Model studies, Simulation analysis, Soil water, Infiltration, Permeability, Base flow, Geomorphology, Rainfall intensity.
Identifiers: Watershed models.

Watershed models were used under a rainfall simulator to determine the nature of the hydrograph response to depth of surface storage medium, model slope, drainage pattern, and drainage density. Tests were made with carefully selected sponge material to represent soil under varying degrees of saturation. Geomorphic features have little or no effect on the hydrograph when there is surficial saturation, but under less than saturated conditions these watershed characteristics do materially affect hydrograph parameters. (Knapp-USGS)
W70-06993

NUMERICAL SOLUTION OF THE BOUSSINESQ EQUATION FOR AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
George M. Hornberger, Janet Ebert, and Irwin Remson.
Water Resources Research, Vol 6, No 2, p 601-608, April 1970. 8 p, 9 fig, 23 ref. NSF Grant GK 4525.

Descriptors: *Surface-groundwater relationships, *Mathematical models, Groundwater movement, Base flow, Recession curves, Saturated flow, Unsaturated flow, Hydrographs, Hydrograph analysis.
Identifiers: Boussinesq equation.

An efficient numerical technique is used to obtain solutions of the Boussinesq equation for problems of groundwater recession and groundwater flow in response to changes in stream stage. The numerical results compare well with the analytical solution of Boussinesq. The solution of a problem involving changing boundary conditions on an aquifer because of a flood wave provides data relative to groundwater outflow. (Knapp-USGS)
W70-07004

EFFECTS OF FOREST COVER UPON HYDROLOGIC CHARACTERISTICS OF A SMALL WATERSHED IN THE LIMESTONE REGION OF EAST TENNESSEE,
Tennessee Valley Authority, Knoxville.
Paul C. Sodemann, and Jones E. Tysinger.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 139-151, 1967. 7 fig, 3 tab, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Watershed management, *Forest management, *Hydrologic budget, *Forest, Runoff, Limestones, Drainage, Drainage effects, Watersheds (Basins), Basins, Rainfall, Discharge (Water), Soil erosion, Gages, Gaging stations, Hydrography.
Identifiers: White Hollow Watershed (Tenn).

The effect of forest cover on hydrologic characteristics was investigated by recording the precipitation, runoff, and sediment data of the White Hollow watershed in eastern Tennessee which is 2,68 square miles in area and underlain by Knox dolomite. The watershed was acquired by the Tennessee Valley Authority and placed under forest protection and management in 1934. The study, based on the data recorded during the 30-yearperiod, shows the reduction of summer peak discharges and total sediment loads and a change in the time of distribution of surface runoff. No appreciable change has occurred in the water yield from the watershed and there has been no change in the volume of either surface runoff or groundwater runoff. (Gabriel-USGS)
W70-07081

2B. Precipitation

TIME DISTRIBUTION CHARACTERISTICS OF RAINFALL RATES,
Illinois State Water Survey, Urbana.
F. A. Huff.
Water Resources Research, Vol 6, No 2, p 447-454, April 1970. 8 p, 6 fig, 2 tab, 6 ref.

Descriptors: *Rainfall disposition, *Time series analysis, *Rainfall intensity, Distribution patterns, Correlation analysis, Statistical methods, Time lag, Rainfall-runoff relationships, Urbanization, Cities.
Identifiers: Rainfall rates.

Data from a 50-storm sample on two dense networks in Illinois were used to investigate the time distribution of 1-minute rainfall rates in warm-season storms. Absolute and relative variability were analyzed for point and mean rates on areas from 25 to 100 square miles. Several variability measures were employed including sequential variability that uses both the magnitude and the sequence of rates in characterizing the time distribution. Since the variability parameters were found to fit closely a log normal distribution, probability distributions were constructed to define interstorm variability relations. Both absolute and relative variability showed a wide range within and between storms, and between areas of different size. Little difference in variability properties was noted between rain and synoptic weather types associated most frequently with warm-season storms. No evidence of regular oscillations in the time distribution of rainfall rates in convective storms was shown by lag correlation analyses. (Knapp-USGS)
W70-06740

SCAVENGING STUDY OF SNOW AND ICE CRYSTALS,
Illinois Inst. of Tech., Chicago.
Sudesh K. Sood, and Meryl R. Jackson.
Report No IIIRI-C6105-10, Illinois Institute Technology Quarterly Progress Report, January 15, 1970. 25 p, 10 fig, 1 tab, 10 ref. USAEC Contract No AT (11-1)-578; IIIRI Proj. C6105.

Descriptors: *Fallout, *Precipitation (Atomospheric), *Aerosols, Laboratory tests, Snowfall, Chemical precipitation, Chemistry of precipitation, Crystallization, Flocculation, Dusts.
Identifiers: Aerosol scavenging.

Scavenging efficiency of naturally precipitating snow and ice crystals for 0.563 micrograms of latex singlets and doublets has been studied. The effect of crystal habit and size on scavenging efficiency has been determined using an electron microscope. Worldwide measurements on deposition of radioactive particles generated by nuclear explosions show that wet removal accounts for more than 80% of the total observed fallout. (Knapp-USGS)
W70-06744

SYNTHETIC RAINFALL DATA,
Nevada Univ., Reno. Desert Research Inst.
Charles K. Stidd.
Available from the Clearinghouse as PB-191 814, $3.00 in paper copy, $0.65 in microfiche. Nevada University Desert Research Institute Preprint No 66, April 1969. 11 p, 6 fig. OWRR Project No A-026-NEV (1).

Descriptors: *Precipitation (Atmospheric), *Statistical methods, *Synthetic hydrology, Statistical models, Weather forecasting, Data processing, Statistical models, Simulation analysis, Computer programs, Time series analysis, Frequency analysis, Forecasting.
Identifiers: Synthetic precipitation data.

A computer generated 'stationary time series' has been modified by processes analogous to those of natural precipitation-producing mechanisms. The resulting numbers have the distributional characteristics of precipitation data. By this means a quantitative explanation is obtained for the skewness in precipitation distributions and the cube-root-normal distribution is verified. (Knapp-USGS)
W70-06758

AIRBORNE TECHNIQUES IN CLIMATOLOGY: OASIS EFFECTS ABOVE PRAIRIE SURFACE FEATURES,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 07B.
W70-06766

INCREASED PRECIPITATION FROM URBAN-INDUSTRIAL EFFECTS,
Illinois State Water Survey, Peoria.
For primary bibliographic entry see Field 04C.
W70-06918

IOWA PRECIPITATION,
Environmental Science Services Administration, Des Moines, Iowa.
Paul J. Waite.
In: Water Resources of Iowa, Symposium Proceedings, Iowa Academy of Science at Univ of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, p 3-15, Jan 1970. 13 p, 12 fig, 13 ref.

Descriptors: *Precipitation (Atmospheric), *Iowa, *Distribution patterns, Synoptic analysis, Climatology, Data collections, Weather data, Rainfall disposition, Water sources, Weather patterns.

Precipitation data collected in Iowa from 1931-1960 are summarized, discussed, and shown graphically. Iowa's 225 precipitation sites are located about 15 miles apart. Control and inspection of sites and observers produces a reasonably good mesoscale precipitation climatology for Iowa. Generally, microscale precipitation climatology is lacking. The annual precipitation varies from near 25 inches in the northwest to 34 inches in the east-central and southeast counties. The crop season precipitation (April through September), totaling some two-thirds of the annual total, exhibits a less pronounced gradient of about 20 inches northwest to around 23 inches in most eastern and southern localities. The cyclic annual pattern of Iowa precipitation varies from little more than an inch in February to nearly 5 inches during June, a direct consequence of the availability of the moisture and the proximity of the eastward moving storms. On nearly half of all the days in the year a trace or more precipitation falls at all Iowa locations. This approximates about two-thirds of the cloudy (about 160 days) and the partly cloudy days (100 to 105 days). The preponderance of rainfall days are with small precipitation amounts. Snowfall, averaging little more than 30 inches per year has varied from a State average of 11.9 inches in 1965-66 to 59.0 inches in 1961-62. (See also W70-06981). (Knapp-USGS)
W70-06982

SYNTHESIS OF URBAN RAINFALL,
Auckland Univ. (New Zealand).
For primary bibliographic entry see Field 06A.
W70-06992

2C. Snow, Ice, and Frost

EVAPORATION OF WATER INTO A SUB-ZERO AIR STREAM,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 02D.
W70-06739

SOME CHEMICAL CHARACTERISTICS OF AEOLIAN DEPOSITS OF SNOW-SOIL ON PRAIRIE WETLANDS,
Fish and Wildlife Service, Jamestown, N. Dak.
For primary bibliographic entry see Field 02J.
W70-06801

GLACIERS OF THE CENTRAL CHILEAN ANDES AND THEIR IMPORTANCE TO THE WATER RESOURCES,
Geological Survey, Menlo Park, Calif.
Austin Post.
US Geological Survey Open-file report, 1970. 5 p, 1 tab.

Descriptors: *Glaciers, *Water sources, *Streamflow, *Runoff, *Water yield improvement, Melting, Regimen, Watershed management, Water supply, Water resources development, Droughts.
Identifiers: Glacier melt modification, Central Andes, Chile.

Recent severe drought in central Chile requires maximum utilization of all water resources. Glaciers contain by far the largest volume of stored water in the area. Their maximum runoff occurs during summer months and dry years when other sources of water are most depleted. By comparing the area of glaciers in river basins with basins in the North Cascades, Washington, where runoff data are available, it is estimated that a minimum of from 35 to 80 percent of the late summer runoff in five Chilean river basins is derived from glaciers. Glacier melt in central Chile for the past century has exceeded ice accumulation, so that streamflow records do not accurately reflect recent precipitation. Although glacier modification to increase runoff during drought is possible, artificial means of increased snow accumulation in glaciers may be required if this source of water is not to be lost. Scientific studies are essential to analyze and put to maximum use and eventually control this important water resource. (Post-USGS)
W70-06989

OBSERVATIONS ON THE GROWTH OF NEEDLE ICE,
Canterbury Univ., Christchurch (New Zealand).
Jane M. Soons, and David E. Greenland.
Water Resources Research, Vol 6, No 2, p 579-593, April 1970. 15 p, 6 fig, 5 plate, 3 tab, 12 ref.

Descriptors: *Frost, *Ice, *Freezing, Soil water, Soil water movement, Frost action, Heat balance, Humidity, Mass transfer, Thawing, Melting.
Identifiers: Needle ice (Frost).

Observations of needle ice were made in the field and in the laboratory. In both situations multitiered needles formed during a single freeze-thaw cycle. Four freeze-thaw cycles were induced in the laboratory. Ice needles grew during each cycle but became less abundant as the soil surface dried out. During the first cycle two-tiered needles grew; in later cycles a layer of frozen soil developed under a single layer of needles. Measurements of soil heat flow, changes of soil moisture, and loss of moisture by evaporation allowed calculations of the heat balance of the surface to be made. These measurements demonstrate the importance of heat released in the conversion of water into ice. Comparison of field and laboratory results shows a contrast in the mechanism of heat loss in the two situations (radiative as opposed to evaporative), but this contrast is unimportant in the formation of ice needles. Water availability appears to be a more important control of ice needle growth. Development of multitiered ice needles is not dependent on the number of freeze-thaw cycles but may result from a critical balance between the soil cooling rate, the amount of available moisture, and the release of heat by conversion of water into ice. (Knapp-USGS)
W70-07005

THE DISPOSITON OF SNOW CAUGHT BY CONIFER CROWNS,
Washington State Univ., Pullman; and Forest Service (USDA), Moscow, Idaho. Forestry Sciences Lab.
Donald R. Satterlund, and Harold F. Haupt.
Water Resources Research, Vol 6, No 2, p 649-652, April 1970. 4 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Interception, *Snow, Snowfall, Snowmelt, Precipitation (Atmospheric), Water loss, Data collections.
Identifiers: Snow interception.

Snow interception studies during the warm winters of 1966-1967 and 1967-1968 in northern Idaho revealed that Douglas fir and western white pine saplings caught about one third of the snow that fell in 22 storms. More than 80% of the snow initially caught in the crowns ultimately reached the ground being washed off by subsequent rain, falling by direct mass release, or dripping as melting snow. Only a small portion was lost by evaporation. (Knapp-USGS)
W70-07008

2D. Evaporation and Transpiration

EVAPORATION OF WATER INTO A SUB ZERO AIR STREAM,
Army Terrestrial Sciences Center, Hanover, N.H.
Yin-Chao Yen, and Gerald R. Landvatter.
Water Resources Research, Vol 6, No 2, p 430-439, April 1970. 10 p, 9 fig, 1 tab, 10 ref.

Descriptors: *Evaporation, *Laboratory tests, Mass transfer, Convection, Air temperature, Water temperature, Humidity, Air-water interfaces, Climatology, Energy budget, Cold regions.
Identifiers: Cold air.

Evaporation of water into sub-zero air stream to simulate water surface conditions during North American winters has been experimentally carried out in an air velocity range form 10 to 160 cm/sec and at air temperatures as low as 20 deg C below that of the water surface. The results can be well represented by an equation in which the Nusselt number for mass transfer is linearly related to the Reynolds number based on the length of the evaporating surface. This correlation gives a value about two and one-half times higher than the result calculated from the Bowen ratio. (Knapp-USGS)
W70-06739

EVAPORATION MEASUREMENTS BY AN EDDY CORRELATION METHOD,
Wisconsin Univ., Madison; and National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.
S. M. Goltz, C. B. Tanner, G. W. Thurtell, and F. E. Jones.
Water Resources Research, Vol 6, No 2, p 440-446, April 1970. 7 p, 5 fig, 12 ref.

Descriptors: *Evaporation, *Humidity, *Eddies, *Data processing, *Meteorological data, Turbulence, Heat budget, Mass transfer, Instrumentation, Microenvironment, Weather data.
Identifiers: Eddy correlation.

Eddy correlation measurements of water vapor flux density were made by using a barium fluoride film humidity sensor and a three-dimensional anemometer. During morning and evening periods good agreement was obtained between eddy correlation data and two other independent methods. Serious disagreement between measurements occurred only when the humidity sensor was operating within a poorly defined portion of the calibration curve that was not suited to on-line calculations. The humidity sensor could be modified to allow operation at all times within linear segment of the calibration curve, thereby permitting successful on-line computer calculations of eddy correlation vapor flux within one meter of the surface. (Knapp-USGS)
W70-06741

AIRBORNE TECHNIQUES IN CLIMATOLOGY OASIS EFFECTS ABOVE PRAIRIE SURFACE FEATURES,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 07B.
W70-06766

WATER REQUIREMENTS OF WATER-FOWL MARSHLANDS IN NORTHERN UTAH,
Utah Water Research Lab., Logan; and Utah State Univ., ogan. Cooperative Wildlife Research Unit.
For primary bibliographic entry see Field 06D.
W70-06995

2E. Streamflow and Runoff

FLOODS IN THE UPPER DES MOINES RIVER BASIN, IOWA,
Geological Survey, Iowa City, Iowa.
Harlan H. Schwob.
Geological Survey Open-file report, April 1970. 49 p, 1 fig, 15 plate, 3 tab, 7 ref, append.

Descriptors: *Floods, *Iowa, Surface waters, Streamflow, Stage-discharge relations, Profiles, Discharge (Water), Frequency analysis, Hydrologic data, Data collections, Stream gages, Gaging stations.
Identifiers: Des Moines River basin (Iowa).

Data on flood stages, discharges, and frequency in the upper Des Moines basin, Iowa are provided in the form of flood-peak records, gaging-station records, frequency curves, and flood profiles. Information is provided for 253 miles of streams from near Boone on the main stem to the Iowa-Minnesota state line on the East and West Forks of the Des Moines River. Flood profiles on the main stem include those for the notable flood of 1954, the lesser flood of 1947, and the computed 25- and 50-year floods. Low-water profiles are shown for all reaches. Tabulations of flood stages and discharges at gaging stations contained in this report can be used for volumetric studies. They can also be used to study the time distribution of stage and discharge above a selected level. (Knapp-USGS)
W70-06736

ERROR ANALYSIS OF STREAMFLOW DATA FOR AN ALLUVIAL STREAM,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-06750

THE HYDRAULICS OF OVERLAND FLOW ON HILLSLOPES,
Geological Survey, Washington, D.C.
Willian W. Emmett.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash. D C 20402 - Price 75 cents. Geological Survey Professional Paper 662-A, pp A1-A68, 1970. 68 p, 41 fig, 6 tab, 42 ref.

Descriptors: *Overland flow, *Rainfall-runoff relationships, *Topography, Turbulent flow, Laminar flow, Slopes, Surface runoff, Sheet flow, Darcy-Weisbach equation, Discharge (Water), Model studies, Hydraulic models, Simulated rainfall, Erosion, Hydraulics, Chezy equation.
Identifiers: Overland flow hydraulics.

Overland flow resulting from rainfall on natural hillslopes responds to the downslope increase in discharge by increasing its depth and velocity. Depth absorbs about two-thirds of the increase in discharge; velocity absorbs about one-third. For straight slope segments investigated in the field, resistance to flow remains nearly constant in the downslope direction. Values of resistance to flow expressed as Manning's n were as high as 1.0 and averaged about 0.5; this roughly corresponded to a Darcy-Weisbach friction factor of 100. Overland flow varies from laminar at the hilltop to fully turbulent at some distance down the slope. When no constraint is placed on slope, the slope for laminar flow increases downslope, the slope for turbulent flow decreases downslope, and a mixed or distrubed flow has an intermediate value or generally constant downslope gradient. This requires that a hillslope must have a convex upper segment, a straight middle segment, and a concave lower segment. This is the slope profile more often than not found in nature. Slope steepness and the length of each segment are controlled by the runoff rate and the initial gradient at the top of the slope. Thus the shape of each slope profile is related to its climatic and geologic environments. (Knapp-USGS)
W70-06751

ANNUAL PEAK DISCHARGES FROM SMALL DRAINAGE AREAS IN MONTANA THROUGH SEPTEMBER 1969,
Geological Survey, Helena, Mont.
M. V. Johnson, and R. J. Omang.
Geological Survey Open-file report, 1970. 139 p, 1 fig.

Descriptors: *Floods, *Small watersheds, *Montana, Stream gages, Peak discharge, Stage-discharge relations, Discharge measurement, Gaging stations, Data collections, Hydrologic data, Streamflow, Roads, Culverts, Hydraulic structures.
Identifiers: Crest-gage stations.

A program to investigate the magnitude and frequency of floods from small drainage areas in Montana was begun July 1, 1955. About 200 stations were in operation from 1963 to 1967, and 185 were in operation in 1968 and 1969. This report is primarily a tabulation, by water year, of the annual peak stage and discharge at each crest-stage gaging station. Also, it summarizes the activities and progress made during the 1969 water year. The program objective is to obtain enough information on the magnitude and frequency of floods in various sizes and types of drainage basins to help design adequate highway drainage structures throughout the state. A method is given for determining the magnitude of floods with 10-yr and 25-yr recurrence intervals. (Knapp-USGS)
W70-06752

MECHANICS OF OPEN-CHANNEL FLOW SYSTEMS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 08B.
W70-06760

QUANTITY AND QUALITY OF LOW FLOW IN THE HONDO CREEK BASIN, TEXAS, MARCH 27-28, 1968,
Geological Survey, San Antonio, Tex.
W. E. Reeves, and P. L. Rettman.
Geological Survey Open-file report, November 1969. 9 p, 2 fig, 2 tab, 2 ref.

Descriptors: *Low flow, *Surface-groundwater relationships, *Recharge, *Water quality, *Texas, Limestones, Aquifers, Water loss, Infiltration, Data collections, Hydrologic data.
Identifiers: Edwards limestone (Tex).

A determination of the gains and losses in a 29.5-mile reach of Hondo Creek near Hondo, Texas, was made on March 27-28, 1968. A net loss of 106 cfs occurred in the reach that contributes recharge to the Edwards and associated limestones. The quality of water showed a general improvement downstream except for sites on and downstream from Verde Creek. (Knapp-USGS)
W70-06774

HYDROLOGIC ENGINEERING TECHNIQUES FOR REGIONAL WATER RESOURCES PLANNING,
Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 07C.
W70-06780

MAXIMUM UTILIZATION OF SCARCE DATA IN HYDROLOGIC DESIGN,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 07C.
W70-06788

THE KINEMATIC CASCADE AS A HYDROLOGIC MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-06843

FLOOD COMPUTATIONS FOR SUBURBS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07A.
W70-06948

SURFACE WATER RESOURCES OF IOWA,
Geological Survey, Iowa City, Iowa. Water Resources Div.
Sulo W. Wiitala.
In: Water Resources of Iowa, Symposium Proceedings, Iowa Academy of Science at Univ of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, p 17-26, Jan 1970. 10 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Water supply, *Runoff, *Distribution patterns, *Iowa, *Water resources, Water resources development, Streamflow, Mississippi River, Missouri River, Water yield, Surface waters.
Identifiers: Surface water resources (Iowa).

The average annual runoff of Iowa ranges from about 2 to 8 inches. The State average is about 6 inches, an amount capable of supplying 5,820 gallons per day per capita. Because of the variability of flow, only a few percent of it is available on a firm basis. The 1960 withdrawal for public water supplies alone was equivalent to nearly 2 percent of the 5,820-gallon per capita supply. The Mississippi River at McGregor and the Missouri River at Sioux City each have an average annual runoff equivalent to about 23,000,000 acre feet. Together, these two stations have an annual flow more than 2 1/2 times the annual runoff from Iowa. No deficiencies in supply are expected for water users living within reach of these border streams. All but one of the four major reservoirs in the State are designed for essentially one purpose--flood control. As population and water use increase, consideration of storage to meet the needs for water supply, waste dilution, and other purposes will follow. (See also W70-06981). (Knapp-USGS)
W70-06983

MAXIMUM FLOODS IN IOWA,
Geological Survey, Iowa City, Iowa. Water Resources Div.
Harlan H. Schwob.
In: Water Resources of Iowa, Symposium Proceedings, Iowa Academy of Science at Univ of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, p 79-86, Jan 1970. 8 p, 1 fig, 2 tab, 6 ref.

Descriptors: *Floods, *Iowa, Rainfall-runoff relationships, Snowmelt, Data collections, Discharge (Water), Stage-discharge relations, Stream gages.
Identifiers: Flood frequency.

The history of floods in Iowa is briefly summarized. At present there are 116 complete-record gaging stations within the borders of the State. The drainage areas for these stations range from 1.33 to over 14,000 square miles. Additionally, as a cooperative project with the Iowa Highway Research Board, flood records are being collected at 134 crest-stage gages which have drainage areas ranging from 0.33 to 252 square miles. Data on maximum known floods for Iowa and for selected midwest states are shown in tables. Because of the relatively short record of streamflow in Iowa and adjacent states, it is not possible to compute the frequency of many extreme events. (See also W70-06981). (Knapp-USGS)
W70-06986

RUNOFF FROM WATERSHED MODELS,
State Univ. of New York, Syracuse. Coll. of Forestry.
For primary bibliographic entry see Field 02A.
W70-06993

AN EXPERIMENTAL INVESTIGATION OF RUNOFF PRODUCTION IN PERMEABLE SOILS,
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 02G.

W70-06996

RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS 3. ESTIMATION AND USE OF A PRIOR DISTRIBUTION,
New South Wales Univ., Kensington (Australia). Dept. of Statistics; and Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
C. A. McGilchrist, T. G. Chapman, and K. D. Woodyer.
Water Resources Research, Vol 6, No 2, p 499-504, April 1970. 6 p, 2 fig 2 tab, 9 ref.

Descriptors: *Water levels, *Flood forecasting, *Frequency analysis, Statistical methods, Probability, Streamflow forecasting.
Identifiers: Flood frequencies, New South Wales (Australia).

The frequency of exceedance of identifiable levels in the banks of rivers has been shown to be approximately constant from site to site in New South Wales, Australia. The parameters of a model which describe this frequency at a site can therefore be regarded as a random selection from a prior distribution which describes the variations from site to site. By assuming an appropriate form for this prior distribution and estimating its parameters from data at a number of sites, the observed record at a particular site in the same region can be extended. (Knapp-USGS)
W70-06998

THE 3-PARAMETER LOGNORMAL DISTRIBUTION AND ITS APPLICATIONS IN HYDROLOGY,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
B. P. Sangal, and Asit K. Biswas.
Water Resources Research, Vol 6, No 2, p 505-515, April 1970. 11 p, 3 fig, 4 tab, 11 ref.

Descriptors: *Statistical methods, *River forecasting, Frequency analysis, Streamflow forecasting, Flood forecasting, Probability.
Identifiers: Lognormal distribution.

The 3-parameter lognormal distribution is a general skew distribution in which the logarithm of any linear function of a given variable is normally distributed. The distribution is applied to the frequency analysis of floods, annual flows, and monthly flows, and a comparison with other commonly used methods suggests that it can be successfully used for this purpose. A procedure for its application has been suggested using only the median, the mean, and the standard deviation of the original data. The Gumbel distribution is a special case, and any straight line on the Gumbel probability paper can be transformed into a straight line on the lognormal probability paper by the 3-parameter lognormal distribution. The sample of 10 stations used in this study all exhibited negative skewness for the logarithms of the data and therefore the lognormal distribution that assumes this skewness equal to zero has generally given high estimates. (Knapp-USGS)
W70-06999

VARIATION OF THE LONGITUDINAL DISPERSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS A FUNCTION OF FRESHWATER INFLOW,
Geological Survey, Philadelphia, Pa.
For primary bibliographic entry see Field 02L.
W70-07000

NUMERICAL SOLUTION OF THE BOUSSINESQ EQUATION FOR AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02A.
W70-07004

STATISTICAL ROUGHNESS PARAMETER AS INDICATOR OF CHANNEL FLOW RESISTANCE,
Pittsburgh Univ., Pa.
Chao-Lin Chiu, and G. Almanzar Rubio.
Water Resources Research, Vol 6, No 2, p 622-628, April 1970. 7 p, 5 fig, 1 tab, 5 ref. OWRR Project C-1146.

Descriptors: *Open channel flow, *Roughness (Hydraulic), *Alluvial channels, Froude number, Statistical methods, Stochastic processes, Channel morphology, Flow resistance.
Identifiers: Channel flow resistance.

In an analysis of field data of four natural rivers a statistical, large-scale roughness parameter has proved effective as an indicator of the channel resistance to the flow when the Froude number based on the mean annual flow is larger than about 0.2. The parameter is derived from the concept that the irregular shape and slope of an irregular alluvial channel may be considered as a result of the random walk of imaginary 'particles' along the channel bed. It is the so-called diffusion coefficient which, according to the stochastic theory of the diffusion process, is normally defined in a diffusion equation as the mean square or the variance of the displacement of the particles during a step of random walk over a constant time interval of length delta t divided by 2 delta t. In the present study, however, delta t represents a constant distance interval instead. The parameter proved to have characteristics similar to those of another large-scale roughness parameter that is derived by other investigators from concepts other than the statistical. This roughness parameter provides a new statistical geometric measure of the irregularities along the entire channel bed and sides that is related to the probability of channel geometry through the diffusion equation, which provides the conceptual basis for its use as a roughness parameter. (Knapp-USGS)
W70-07013

VELOCITY MEASUREMENT WITH RADIOACTIVE SPHERES,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 07B.
W70-07015

FLOODS IN SYMERTON QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07017

STATISTICAL MODEL OF TURBULENCE IN SEDIMENT-LADEN STREAMS,
Kansas State Univ., Manhattan; and Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-07022

WATER RESOURCES OF THE PINE RIVER BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07028

A PILOT STUDY OF STORAGE REQUIREMENTS FOR LOW FLOW AUGMENTATION,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 05G.
W70-07029

THE BASIC HYDROLOGIC CHARACTERISTICS OF THE KARST RIVER LJUBLJANICA,
Hydrometeorological Inst., Ljubljana (Yugoslavia).
Friderik, Lewicki.
French summary. Hydrology of Fractured Rock Proceedings of Dubrovnik Symposium (Octob 1965), International Association of Scientif Hydrology, Publication No 73, p 255-262, 1967. fig, 2 tab.

Descriptors: *River flow, *Karst, *Surface-groun water relationships, *Hydrogeology, River basin Flow characteristics, Floodwater, Groundwat basins, Runoff, Precipitation (Atomospheric), I filtration, Water storage, Water supply, Water lev fluctuations, Springs, Gaging stations, Discharg measurements.
Identifiers: Ljubljanica river, Yugoslavia.

The hydrologic characteristics of the Ljubljanic river flowing over the surface of a karstic area we investigated by analysis of water-discharges ar other pertinent data. The analyzed data for th river then were compared with the simil hydrologic data characterizing the neighborin Sava and Soco rivers. During periods of heav precipitation in flat areas, where water flows abo ground levels, floods occur owing to the small infi tration capacity of the surface layer. Since th water is both retained on the surface of karst areas and accumulated underground, the springs the Ljubljanica river area are fairly constant. Th special hydrologic characteristics of Ljubljanic caused by the karstic features of the drainage basi have a considerable effect on the downstrea hydrologic conditions, especially those of the Sav river. (Gabriel-USGS)
W70-07091

VARIATION OF ALPHA AND BETA VALUE IN A LINED OPEN CHANNEL,
Colorado State Univ., Fort Collins. Coll. of E gineering, and Geological Survey, Fort Collins.
Frederick J. Watts, Daryl B. Simons, and Everett V. Richardson.
Journal of the Hydraulics Division, ASC Proceedings, Vol 93, No HY6, p 217-23 November 1967. 9 fig, 2 tab, 5 ref, append. Pap 5593.

Descriptors: *Open channel flow, *Mathematic studies, *Mannings equation, *Discharge coef cients, Reynolds number, Roughness (Hydraulic Uniform flow, Energy, Hydraulics.
Identifiers: Open channel hydraulics.

A study of the variation in magnitude of the ener coefficient, alpha, and the momentum coefficien beta, was conducted for subcritical open-chann flow in concrete-lined trapezoidal canals contai ing horizontal curves. The Manning's n was 0.0 for reaches without bends; values of alpha and be were found to be smaller than values proposed current literature, and there was only small vari tion of alpha and beta values with stage, chann geometry, position, and radius of curvature. For a cross sections analyzed, the energy and momentu coefficients may be considered constant wi values of 1.04 and 1.02, respectively. (Knap USGS)
W70-07092

2F. Groundwater

RECORDS OF OBSERVATION WELLS AN WATER-LEVEL FLUCTUATIONS IN TH ABERDEEN-SPRINGFIELD AREA, BINGHA AND POWER COUNTIES, IDAHO, IN 1968
Geological Survey, Boise, Idaho.
For primary bibliographic entry see Field 04B.
W70-06732

GROUND-WATER CONDITIONS IN A GELINA AND NACOGDOCHES COUNTIE TEXAS.
Guyton (Willian F.) and Associates, Austin, Tex.

Report published and distributed by the Tex Water Development Bd, P O Box 12386, Austi

ex. 78711. Texas Water Development Board Report 110, March 1970. 125 p, 47 fig, 12 tab, 54 ref.

escriptors: *Water resources, *Groundwater, Aquifers, *Texas, Water wells, Water yield, Vater quality, Transmissivity, Water supply, ands, Sandstones, Water levels, Withdrawal, Vater resources development, Recharge, ischarge (Water), Water utilization.
lentifiers: Angelina County (Tex), Nacogdoches ounty (Tex).

roundwater conditions were surveyed in Angelina nd Nacogdoches Counties, in the rolling hills, iney woods portion of east Texas. The geologic rmations which constitute the principal aquifers re the Carrizo Sand, Wilcox Group, Yegua Forıation, and Sparta Sand. Of these the Carrizo is by ır the most productive. Each of the formations rops out in the area and dips to the south. Because ıe aquifers are full to overflowing, most of the echarge is rejected in the outcrops as evapotransiration and seepage in the stream valleys. Total umpage from Carrizo wells in 1968 is estimated at 6.7 million gpd. Yields of individual wells range rom a few gallons per minute to nearly 1,500 gpd. he estimated total supply available from Carrizo ells under practical conditions, without causing ıe failure of some of the present well fields and rying up portions of the aquifer, is 32 million gpd. umpage from the Wilcox Group was only 0.5 milon gpd in 1968. The estimated potential yield of ıe Wilcox sands to wells is 8 million gpd. Estiıated pumpage from the Yegua Formation in 1968 as 2.8 million gpd. The estimated potential yield rom wells in the Yegua Formation is 7 million gpd. Estimated pumpage in 1968 from the Sparta Sand as only 0.1 million gpd. The estimated potential ield of this sand to wells is 7 million gpd. No vidence has been found of any serious contaminaion of groundwater from oil-field brines. There is ome possibility of future encroachment of rackish water in the Carrizo and Yegua Formaions. (Knapp-USGS)
W70-06737

GROUNDWATER DATA FOR ORANGE COUNTY AND VICINITY, TEXAS AND LOUISIANA, 1969,
Geological Survey, Austin, Tex.
Gene D. McAdoo.
Geological Survey Open-file report, 1970. 22 p, 4 ig, 5 tab, 2 ref.

Descriptors: *Hydrologic data, *Water levels, Water quality, *Aquifers, Texas, Groundwater, Water level fluctuations, Louisiana, Water utilizaion, Water yield, Withdrawal, Water wells, Monioring, Data collections.
Identifiers: Orange County (Tex).

A network of 94 observation wells was maintained or water-level measurements during 1969 in Orange County, the southern parts of Jasper and Newton Counties, the eastern part of Jefferson County, the southeastern part of Hardin County, all n Texas; and the western parts of Cameron and Calcasieu Parishes, Louisiana. The heaviest concentration of observation wells is within the industrial area in the southern part of Orange County. The locations of water-level observation wells are shown on a map Static water-level measurements were made generally in the early part of the year at he time of least interference from pumping and maximum recovery from the previous heavy seasonal pumping. Pumping water-level measurements were made during the latter part of the year at the time of maximum drawdown of water levels. A network of 58 wells to observe changes in chemical quality of the groundwater was maintained during 1969 in Orange County. Data on groundwater pumpage for all major uses during the period 1963-68 are given. (Knapp-USGS)
W70-06746

HYDROGEOLOGICAL RECONNAISSANCE OF THE NORTH NASHWAAKSIS BASIN, NEW BRUNSWICK,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
J. E. Charron.
Inland Waters Branch Technical Bulletin No 20, Department of Energy, Mines and Resources, 1969. 48 p, 36 fig, 7 tab, 7 ref.

Descriptors: *Hydrogeology, *Groundwater basins, Aquifers, Water wells, Water quality, Geohydrologic units, Surveys, Investigations, Water sources, Water levels, Water yield.
Identifiers: *Nashwaaksis basin (New Brunswick), Canada.

The North Nashwaaksis basin (New Brunswick, Canada) is one of three small perched basins, situated on a plateau between the larger Keswick and Nashwaak River basins. Surficial deposits consist of impermeable glacial-deposited till (ground moraine) and some bouldery outwash along the bed of the North Nashwaaksis Stream near the southern end of the basin. Bedrock is for the most part relatively uniform, almost horizontal, permeable sandstone with some conglomerate rocks outcropping. Reconnaissance of the area consisted of traversing the basin throughout its entire length to locate springs and future drill sites, gather water samples, map rock outcrops and find areas of recharge. The data collected provided a basis for the study of three specific aspects of the hydrogeology of the basin: (1) a temperature study of surface and subsurface water; (2) a partial quantitative study of the sandstone aquifer that underlies the basin; (3) a very good hydrochemical interpretation of groundwater movement as shown by the analyses of 37 surface and subsurface water samples. In addition, some of the data collected can be used in a low flow study of the basin. (Knapp-USGS)
W70-06765

HYDROGEOLOGY OF THE BEREA AND CUSSEWAGO SANDSTONES IN NORTHEASTERN OHIO,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-06784

GROUNDWATER FAVORABILITY AREAS AND SURFICIAL GEOLOGY OF THE LOWER KENNEBEC RIVER BASIN, MAINE,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-06790

GROUNDWATER RESOURCES OF CRAVEN COUNTY, NORTH CAROLINA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-06791

COARSE MEDIA FILTRATION FOR ARTIFICIAL RECHARGE,
Illinois State Water Survey, Urbana; and Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 04B.
W70-06793

GENESIS OF SOME GROUNDWATERS FROM IGNEOUS ROCKS,
Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02K.
W70-06799

THE EQUATION OF GROUNDWATER FLOW IN FIXED AND DEFORMING COORDINATES,
Geological Survey, Washington, D. C. Water Resources Div.
Hilton H. Cooper, Jr.
Journal of Geophysical Research, Vol 71, No 20, p 4785-4790, October 15, 1966. 6 p, 7 ref.

Descriptors: *Groundwater movement, *Mathematical studies, Flow, Porous media, Darcy's law, Permeability, Non-uniform flow, Unsteady flow, Drawdown, Transmissivity, Porosity, Storage coefficient.
Identifiers: Jacob's equation.

Two forms of the equation of flow of a compressible liquid in an elastic porous medium are derived by considering mass conservation in (1) a control volume whose boundaries are fixed in space and (2) a control volume that deforms and moves through space when the material deforms. The first method yields a form of the equation that necessarily involves the velocity of the grains of the medium. The second yields a form that does not involve the grain velocity. Jacob's equation is found to be correct when negligible terms are omitted. (Knapp-USGS)
W70-06802

ON THE STORAGE COEFFICIENT AND THE EQUATIONS OF GROUNDWATER FLOW,
Princeton Univ., N. J. School of Engineering and Applied Science.
Roger J. M. De Wiest.
Journal of Geophysical Research, Vol 71, No 4, p 1117-1122, February 15, 1966. 6 p, 2 fig, 10 ref.
NSF Grant GE-7269.

Descriptors: *Storage coefficient, *Aquifers, Mathematical studies, Groundwater, Groundwater movement, Darcy's law.
Identifiers: Specific storage.

Specific storage of an elastic aquifer is redefined, and the storage coefficient which was first computed by C. E. Jacob is derived in the transition from three-dimensional flow to two-dimensional flow. The equation for groundwater flow in a homogeneous, isotropic medium is derived from the exact expression of Darcy's law for compressible fluid flow. (Knapp-USGS)
W70-06803

AN APPROACH TO MANAGEMENT AND OPTIMAL UTILIZATION OF AQUIFERS,
Technion - Israel Inst. of Tech., Haifa.
Jacob Bear, and O. Levin.
In: Proceedings of the Second Annual American Water Resources Conference, American Water Resources Assn., Urbana, Ill., 1966. p 200-212, 4 fig, 2 ref.

Descriptors: *Aquifers, *Artificial recharge, *Aquifer characteristics, *Hydrology, *Groundwater, *Groundwater recharge, *Leakage, *Management, *Mathematical models, *Planning, *Optimization, *Natural recharge, *Recharge, *Safe yield, Water resources, Water supply, Storage, Reservoir storage, Spring waters, Import, Export, Seasonal, Conduits, Flow, Filters, Mixing, Constraints, Benefits, Distribution systems, Quality control, Legal aspects, Technology, Boundary processes, Decision making.
Identifiers: *Excitation-response relationships, *Aquifer geology, *Groundwater utilization, *Marginal analysis, Import-export relationships, Stochastic input, Single cell aquifers, Mixers, Controlled pumpage, Technological aspects, Objective functions.

The role of groundwater aquifers in developed water resource systems as renewable sources of water, as large storage reservoirs, conduits and distributional systems, controls for spring and river flow and as filters or mixers of injected water in quality control operations, is described and analyzed. Groundwater hydrology describes the excitation-response relationships in an aquifer. The conventional approach where decisions by hydrologists and planners on groundwater utilization are based solely on physical relationships, and on the knowledge of aquifer geology, is described.

The drawback of defining safe yield according to this physical approach and the need for other criteria are discussed. The problem of groundwater utilization is formed as a management problem where the aquifer is to be operated in an optimal manner. The mathematical model on which this approach is based is described. They hydrological excitation response relationships serve as constraints for the operation of the system. Sometimes technological, legal or other restrictions are also involved. The dynamic nature of the problem and the special features of the aquifer: stochastic input in the form of natural replenishment and the leakage through boundaries, depending on water table elevations, is discussed. The solution of the aquifer management problem is based on known optimization techniques in which: the special physical nature of the aquifer is introduced; and a marginal analysis technique is included to increase the efficiency of the solution procedure. The case of a single-cell aquifer is analyzed as an example of the proposed approach. The results provide a new quantitative definition of safe yield. (Richmond-Chicago)
W70-06848

UNCONFINED AQUIFER SEEPAGE BY CAPILLARY FLOW THEORY,
Cornell Univ., Ithaca, N.Y.
Rameshwar D. Verma, and Wilfried Brutsaert.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY6, Paper 7363, p 1331-1342, June 1970. 12 p, 5 fig, 16 ref, append. FWPCA Fellowship No 1-F1-WP-26-266-01 and 02.

Descriptors: *Groundwater movement, *Aquifers, *Numerical analysis, Seepage, Unsaturated flow, Saturated flow, Unsteady flow, Capillary water, Equations.
Identifiers: Finite difference methods.

A numerical scheme is presented to analyze a two-dimensional unconfined aquifer of rectangular cross section to determine the fall of the water table, the water content and the rate of outflow into an adjoining water body which fully penetrates the aquifer. The capillary or unsaturated flow above the water table is considered through the use of Richards' equation. It was found that the problem can be solved by an alternating explicit-implicit finite difference scheme. It has the advantage of being efficient and of being suitable even when the fully saturated flow zone is very small. The unknown position of the seepage surface and the unknown boundary between the saturated and the unsaturated zone constitute a very critical aspect of the calculations. (Knapp-USGS)
W70-06978

GROUNDWATER RESOURCES OF IOWA,
Geological Survey, Iowa City, Iowa; and Iowa State Geological Survey, Iowa City.
W. L. Steinhilber, and P. J. Horick.
In: Water Resources of Iowa, ,Symposium Proceedings, Iowa Academy of Science at Univ of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, p 29-49, Jan 1970. 21 p, 5 fig, 1 tab, 8 ref.

Descriptors: *Groundwater, *Water resources, *Aquifers, *Iowa, Water yield, Water quality, Water supply, Withdrawal, Stratigraphy, Water wells, Sandstones, Limestones, Alluvium, Hydrogeology, Hydrologic data, Reviews.
Identifiers: Hydrogeologic units (Iowa).

A general description is presented of the physical, hydrologic, and water-yielding characteristics of the six principal aquifers in Iowa's groundwater reservoir. The six principal water-yielding rock units in the Iowa reservoir are the surficial deposits, the Dakota Sandstone of Cretaceous age, limestones and dolomites of Mississippian age, limestones and dolomites of Silurian and Devonian age, the Cambrian and Ordovician sandstones and dolomites, and the Dresbach sandstones of Cambrian age. The most consistently productive units are the Cambrian and Ordovician sandstones and dolomites. Others that are highly productive locally are the alluvium (surficial deposits), the Dresbach and Cretaceous snandstones, and limestones or dolomites of Silurian, Devonian, or Mississippian age where they directly underlie major streams. Stratigraphic and hydrogeologic details are tabulated. (See also W70-06981). (Knapp-USGS)
W70-06984

APPLICATION OF A STATISTICAL ZONATION METHOD TO RESERVOIR EVALUATION AND DIGITIZED-LOG ANALYSIS,
Michigan Univ., Ann Arbor. Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 07C.
W70-06991

NUMERICAL SOLUTION OF THE BOUSSINESQ EQUATION FOR AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02A.
W70-07004

A MEAN VALUE THEOREM IN PORE PRESSURE EVALUATION BY THE METHOD OF IMAGES,
McGill Univ., Montreal (Quebec).
For primary bibliographic entry see Field 04B.
W70-07009

MOIRE PATTERN TECHNIQUES IN GROUNDWATER HYDROLOGY,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
For primary bibliographic entry see Field 07A.
W70-07011

GROUNDWATER RESOURCES OF THE LAMBAYEQUE VALLEY, DEPARTMENT OF LAMBAYEQUE, NORTHERN PERU,
Geological Survey, Washington, D.C., and Servicio Cooperativo Interamericano de Irrigacion, Vias de Comunicacion, e Industrias.
Stuart L. Schoff, and Juan Luis Sayan M.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402. U S Geological Survey Water-Supply Paper 1663-F, p F1-F77, 1969. 77 p, 24 fig, 3 plate, 19 tab, 19 ref.

Descriptors: *Groundwater, *Water resources, *Arid lands, Irrigation water, Water yield, Aquifers, Water wells, Water quality, Water sources, Water resources development, Hydrologic data, Data collections, Hydrogeology.
Identifiers: Lambayeque (Peru).

Groundwater in the Lambayeque Valley, Peru has been developed mainly for irrigation of sugarcane and rice. The available water, whether in streams or underground, is introduced from the Andean highlands by Rio Chancay. In the northern part of the area wells locally yield water rather freely from strata as deep as 73 m, but eleswhere in the area the strata deeper than 20 m are not very productive. The recharge is sufficient to offset withdrawal at a rate of about 81 million cu m per year. A study of the effect of protracted pumping on yields of wells suggests that the rate of recharge locally, and for a short period, was more than 76,000 cu m per day. A pumping test showed the transmissivity to be about 950 cu m per day per m and the storage coefficient to be about 0.07. Based on these coefficients, the drawdown caused by one well discharging 10 liters per second for 6 months would be only 0.066 m at points 4,000 m distant, but 50 wells at the same rate and distance would create 3.3 m of drawdown. The waters from wells of the Lambayeque Valley compare favorably, in most respects, with the standards established by the U. S. Public Health Service for water for human consumption. The average yield obtained from a meter of water-bearing stratum has been 6.7 liters per se in initial pumping tests but only 3.5 liters per se under steady pumping. The average yield per mete of installed well screen was 4.9 liters per sec in in tial tests but declined under steady pumping to 2. liters per sec. (Knapp-USGS)
W70-07026

WATER RESOURCES OF THE PINE RIVE BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07028

BASIC TRANSPORT COEFFICIENTS A AQUIFER CHARACTERISTICS,
Water Planning for Israel Ltd., Tel-Aviv.
Y. Bachmat.
French Summary. Hydrology of Fractured Rock Proceedings of Dubrovnik Symposium (Octob 1965), International Association of Scientif Hydrology, Publication No 73, p 63-75, 1967. ref.

Descriptors: *Groundwater, *Aquifers, *Aquif characteristics, Hydrologic properties, Hydrolog equation, Flow characteristics, Mathematical st dies, Mathematical models, Probability, Statistic models, Parametric hydrology, Discharge (Wate Porosity, Porous media.
Identifiers: Israel.

A general approach to aminar steady flow of an i compressible homogeneous liquid through an ine and stable porous medium is presented. The anal sis is carried out using some probability concepts. is shown that the mass flow is governed by an a gebraic equation of second order with respect the average specific discharge. The averaged me um parameters, which appear in this equation, a funtions of the statistical distributions of the me um's geometric properties in the neighborhood o point in space. The physical meaning of the parameters is discussed; ways to measure them a to use them as means for classification of aquife are indicated. (Gabriel-USGS)
W70-07071

APPROACH TO THE PROBLEM OF THE U DERGROUND WATER LEAKAGE FROM TH STORAGES IN KARST REGIONS, KARS STORAGES BUSKO BLATO, PERUCA AN KRUSCICA,
Mladen Borelli, and Boris Pavlin.
French Summary. Hydrology of Fractured Rock Proceedings of Dubrovnik Symposium (Octob 1965), International Association of Scienti Hydrology, Publication No 73, p 32-62, 1967. fig, 1 tab, 7 ref.

Descriptors: *Groundwater movement, *Kar *Groundwater basins, Reservoir leakage, Groun water, Aquifers, Reservoir storage, Water lo Water level fluctuations, Geologic formatio Geologic mapping, Hydrogeology, Hydrologic pr perties, Permeability, Leakage, Frequency analys
Identifiers: *Yugoslavia.

Analytical and experimental studies were made three reservoirs in the Yugoslavian Karst regi The analysis was based on the application statistical methods and on an assumption that relationship exists between the general hydrau conditions of fissured rocks and the existence of dividual large caverns and channels. The appli tion of statistical analysis for the determination the zones of high permeability and their variance depth is of considerable value, although in Kars regions the method leads to very rough estimat (Gabriel-USGS)
W70-07072

CIRCULATION OF KARSTIC WATERS CALCAREOUS COMPLEXES AND ITS QUA TITATIVE BALANCE (IN FRENCH),
Eugen Kullman.

English summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 152-160, 1967. 2 fig, 2 tab, 4 ref.

Descriptors: *Groundwater, *Karst, *Water balance, *Water circulation, Water yield, Hydraulic properties, Water resources, Flow characteristics, Geology, Hydrogeology, Precipitation (Atmospheric), Discharge measurement, Water resources, Water storage.
Identifiers: Czechoslovakia, Carpathians.

Recharge and exhaustion of karstic water reserves of the western Carpathians are described and water-balance calculation are used for the quantitative estimation of the Triassic water resources. The evaluation of the Karst-water balance of this area was based on the knowledge of specific underground flows in the different calcareous complexes and detailed observations of various hydrologic and hydraulic properties. Between 40 and 50% of the underground water of the calcareous complex passes below the geological strata of the plain and the evaluation of his plain's water balance confirms this estimate. Some reliable data are given on specific flow values and water circulation in the various geologic, tectonic, and climatic areas of the western Carpathians. (Gabriel-USGS)
W70-07073

EXPLOITATION OF A CAPTIVE KARSTIC AQUIFER DISCHARGING THROUGH SUBMARINE SPRINGS-PROBLEMS ARISING AND SOLUTION ADOPTED LEBANESE COAST (IN FRENCH),
Louis Moullard, Borivoje Mijatovic, Rene Kareh, and Bernard Massaad.
English summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 237-250, 1967. 6 fig.

Descriptors: *Hydrologic properties, *Spring waters, *Karst, *Exploitation, Water balance, Water level fluctuations, Water resources, Water sources, Water storage, Water yield, Limestones, Dolomite, Water levels, Velocity, Water analysis, Geochemistry, Pumping.
Identifiers: *Lebanon, Karstic aquifer exploitation.

The aquifers of the Coastal region of North Lebanon, which discharge water to the sea at the rate of 50 cu m/sec were analytically and experimentally investigated. One possibility studied was the invasion of the aquifers by sea water when the pressure is lowered by withdrawal and the other possibility was the tapping of karstic aquifers at the points where underground flow and pressure are favorable to help prevent such invasion. (Gabriel-USGS)
W70-07074

GROUNDWATERS AT THE BASE OF NONLAMINATED HARD STRATA AND CAVERNS AT THEIR LOWER CONTACT (IN FRENCH),
Ernst Sobotha.
English summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 184-189, 1967. 5 fig, 6 ref.

Descriptors: *Groundwater movement, Geology, *Karst, *Water circulation, Aquifers, Limestones, Dolomite, Alluvial channels, Structural geology, Water structure, Water table, Boreholes.
Identifiers: Burgwald (Hesse).

In regions of thick nonlaminated hard rock strata, water of infiltration accumulates in fissures, joints and brecciated zones. If there is a permeable weathered layer, water infiltrates rapidly. The flow of underground water and discharge from springs are both considerable. If the hard strata have undergone tectonic alteration by pressure and tension, karstic phenomena are encountered even in compacted sandstones, as in the neighborhood of the Burgwald in Hesse. In calcareous terrains, karst problems are satisfactorily known, but there is little knowledge of the importance of the base zone of compacted nonlaminated beds, where, particularly in the synclinals, tectonic action opens diaclases. In this zone the water forms a system of caverns along the lower contact of the inclined beds. Examples are to be found in Iran, Sicily, Tunisia and Yugoslavia. This is difficult country for dam building, but it does carry water down to the depths rapidly and recharges the artesian reservoirs with relatively cold water. (Gabriel-USGS)
W70-07075

HYDROLOGICAL AND HYDRAULIC CHARACTERISTICS OF WATERS FLOWING FROM FISSURED CARBONATED ROCKS INTO MINES,
Dorog Coal Mining Trust (Hungary).
T. Tettamanti.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 106-119, 1967. 10 fig, 2 tab.

Descriptors: *Groundwater, *Aquifers, *Hydrologic properties, Flow measurement, Flow characteristics, Geology, Fissures (Geology), Groundwater basins, Pumping, Mine water, Mine drainage, Hydrodynamcis, Hazards, Well casings, Acidic water, Dam construction.
Identifiers: *Hungary, Coal mine hydrology.

Hydrologic and hydraulic characteristics of water flows present in the Karstic and fractured zones of carbonaceous formations in the Metalliferous areas of the Transdanubian Range were investigated on the basis of water-pumping and water-level data observed in several mines. Some methods of protection against water were also investigated. (Gabriel-USGS)
W70-07076

ANALYSIS OF PUMPING TEST IN FRACTURED ROCKS,
Egyptian Desert Inst., Cairo.
Nabil Rofail.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 81-88, 1967. 4 fig, 1 tab, 4 ref.

Descriptors: *Groundwater movement, Aquifers, *Hydraulic properties, *Flow characteristics, Mathematical studies, Mathematical models, Fissures (Geology), Transmissivity, Piezometry, Diffusivity, Aquifer characteristics, Hydrologic equation, Geology, Porous media, Porosity.
Identifiers: Aquifer testing, Nile Delta, Egypt.

The constants of fissured aquifer formations were analytically investigated by using the Kotchina equation of radical flows and assuming that the flow takes place through a medium of double porosity that is, matrix porosity and the porosity of the fissures. Transmissivity, piezometric diffusivity and a new specific constant characterizing the size of fissures were taken as hydraulic constants. After setting a differential equation for pumping at constant rate, the equation was solved and the formation constants were determined by using curve type methods. Drawdown distribution was also evaluated and given in a tabular form for small time values. (Gabriel-USGS)
W70-07077

EFFECT OF IMPERVIOUS BARRIERS OF DEEP-SEATED FRACTURES ON GROUNDWATER FLOW,
Egyptian Desert Inst., Cairo.
Kamal F. Saad.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 76-80, 1967. 2 fig, append.

Descriptors: *Aquifers, *Groundwater movement, *Aquifer characteristics, *Hydraulic properties, Transmissivity, Storage, Storage coefficient, Fractures (Geology), Flow characteristics, Fissures (Geology), Permeability, Steady flow, Water storage, Groundwater barriers, Water wells, Mathematical studies, Mathematical models.

The hydraulic properties of an aquifer that is partially opposed by a barrier are analytically investigated by assuming the concept of an unsteady radial flow toward a water well and using the theory of images. It is also assumed that the water well is located near a fault which partially opposes the ground water flow and that the amount of fault displacement maybe estimated. By plotting an analytical parameter (m) versus time, the inflection point of this curve can be found and the transmissivity and storage capacity of an aquifer can be determined. (Gabriel-USGS)
W70-07078

PROBLEM OF THE DEMARCATION OF DRAINAGE BASINS AND DIRECTIONS OF FLOW OF UNDERGROUND STREAMS IN THE DINAR KARST (IN FRENCH),
Institute for Geological and Geophysical Research, Belgrade (Yugoslavia).
Miomir Komatina.
English summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (Octber 1965), International Association of Scientific Hydrology, Publication No 73, p 190-199, 1967. 8 fig, 4 ref.

Descriptors: *Groundwater movement, *Karst, *Water circulation, Hydraulic systems, Groundwater, Groundwater basins, Hydrogeology, Geomorphology, Geology, Fissures (Geology), Faults (Geology), Limestones, Dolomite, Water sources.
Identifiers: Dinaric Alps, Yugoslavia.

Karstic drainage basins of the Dinaric Alps were investigated with special attention given to the study of fracturing in carbonate rocks as a leading factor for the development of zones of Karstification. The study confirms the value of geologic and hydrologic data and the value of reliable mapping of fissure zones for the demarcation of groundwater zones and determination of groundwater-flow directions. (Gabriel-USGS)
W70-07079

RESEARCH IN THE BOETIAN KARSTIC LAKES REGION (IN FRENCH),
G. G. Mistardis.
English summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 162-170, 1967. 3 fig, 13 ref.

Descriptors: *Groundwater, *Karst, *Hydrologic properties, Hydrologic data, Hydrologic aspects, Geology, Lake basins, Tunnels, Drying, Engineering structures, Water resources, Erosion, Topography, Climatic zones, Forecasting, Water level fluctuations.
Identifiers: *Greece, Boetia.

The hydraulic history and the geological and hydrological conditions of the Karstic lakes region of Boetia, Greece are outlined. Even after the draining of Lake Copais in 1892, the Karstic springs continued to be abundant, indicating that an important Karstic water network exists in the deeper part of the region. The origin of these Karstic networks and the level fluctuations of the lakes, beginning with Pliocene epoch, are also discussed. (Gabriel-USGS)
W70-07080

THE HYDRAULIC PROPERTIES AND YIELD OF DOLOMITE AND LIMESTONE AQUIFERS,
Illinois State Water Survey, Urbana.
Sandor C. Csallany.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 120-138, 1967. 14 fig, 9 ref.

Descriptors: *Illinois, *Aquifers, *Hydraulic properties, *Water resources, Dolomite, Limestones, Aquifer characteristics, Groundwater, Water wells, Test procedures, Geology, Fissures (Geology), Transmissivity, Porosity, Permeability, Storage capacity.
Identifiers: *Carbonate rock aquifers, *Aquifer testing.

In Illinois large quantities of groundwater are withdrawn from wells in dolomite and limestone wells of Mississippian, Silurian, and Ordovician age. About 1,250 well production tests were made on more than 1,000 wells. During aquifer tests interference between wells spaced more than one-half mile apart was measurable, indicating that water-yield openings in rocks extend for considerable distances. The dolomite and limestone contains numerous interconnected fractures and crevices. The controlled pumping test method may describe the hydraulic properties of the dolomite and limestone on an areal basis, but does not accurately describe the drawdown in the immediate vicinity of a pumped well. Statistical analysis of adjusted specific capacity data is probably the best method to determine the yields of wells on an individual and regional basis because of the interconnection of fractures and inconsistency in yields. Rough estimates were made of the coefficients of transmissibility of the shallow dolomite based on average specific capacity data. The probable ranges in yields of dolomite and limestone wells in undeveloped areas are estimated from specific capacity frequency graphs, aquifer thickness and areal geology maps, and water level data. (Gabriel-USGS)
W70-07082

WATER BALANCE INVESTIGATIONS IN THE KARSTIC REGIONS OF HUNGARY,
Research Inst. for Water Resources Development, Budapest (Hungary).
H. Kessler.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 91-105, 1967. 6 fig, 2 photo, 4 ref.

Descriptors: *Groundwater movement, *Aquifers, *Water balance, *Karst, Precipitation (Atomospheric), Water circulation, Water levels, Water measurement, Water sources, Water supply, Water demand, Mine drainage, Infiltration, Forecasting, Wells, Geology.
Identifiers: *Hungary.

Precipitation, water levels, annual yields of springs, and other pertinent data recorded in the Karstic regions of Hungary for a number of years are analyzed. The invetigation was based on a principle that the knowledge of hydraulic and hydrologic patterns of a Karstic area should lead to a correct estimate of the size of its catchment and its dynamic water supply on the basis of the annual yields of springs. To observe water levels, observation wells have also been located in areas subject to artificial interventions such as mining. A significant increase in the Karstic water levels and, in consequence, the accumulation of dynamic water supplies takes place in the first four months of the year, as a result of snowmelts. Flow velocities (50-150 m/hour), observed in the course of this study demonstrate the relationship between swallows and karstic springs. (Gabriel-USGS)
W70-07083

KARST HYDROGRAPHY (IN FRENCH),
Franc Jenko.
English summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 172-182, 1967. 5 fig.

Descriptors: Hydrography, *Karst, *Hydrographic analysis, *Groundwater, Geology, Hydrologic properties, Aquifers, Aquifer characteristics, Geochemistry, Geophysics, Dolomite, Limestones, Water table, Water balance, Water level fluctuations, Water resources, Water sources, Carbon dioxide, Velocity, Water wells.
Identifiers: Yugoslavia.

The hydrography of a typical Karstic area is described on the basis of numerous earlier publications. The use of bores and geophysical methods in Karstic terrains reveal the presence of undulating water tables separated horizontally and vertically at various depths. Stream often rise in relatively impermeable formations and then flow over the surface or in underground channels. It is also suggested that aquifers associated with undulating water tables carry very large water reserves down to great depths. Some hydromechanical principles of Karstic waters in contact with sea waters are also explained. (Gabriel-USGS)
W70-07084

GROUNDWATERS AND CHANNELS OF KARST AREAS (IN FRENCH),
Consejor Superior di Investigaciones Cientificas, Madrid (Spain). Dept. of Hydrogeology.
N. Llopis Llado.
Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Pubication No 73, p 200-203, 1967. 3 fig.

Descriptors: *Groundwater movement, *Karst, *Water circulation, *Channel flow, Geology, Permeability, Limestones, Dolomite, Aquifers, Marl, Conglomerate rocks, Porosity, Fissures (Geology), Fractures (Geology).
Identifiers: Island of Majorca, Spain.

The effect of fissures in calcareous rocks on water circulation was investigated on the basis of geological and hydrological data obtained in the Llenaire calcareous massif of Majorca. The aquifer circulation of a karstic groundwater reservoir is usually well developed in folded regions or where the fissure density is well developed. The existence of initial sedimentary porosity also favors the development of aquifer circulation. Channel circulation, however is very common in calcareous complexes which are slightly tectonized. (Gabriel-USGS)
W70-07085

HYDRODYNAMIC ZONING OF KARST WATER,
Gosudarstvennyi Geologicheskii Institut, Leningrad (USSR).
D. S. Sokolov.
Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 204-207, 1967.

Descriptors: *Groundwater, *Karst, *Water circulation, Hydrodynamics, Water levels, Water level fluctuations, Flow characteristics, Climates, Fissures (Geology), Geochemistry, Diffusion, Permeability, Aeration, Drainage, Soil physical properties.
Identifiers: *Hydrodynamic zoning.

A scheme of vertical hydrodynamic zoning of karst waters accumulated in the thick strata of carbonate and sulfate rocks is outlined. This scheme consists of four vertical zones with their characteristic movements and other conditions. The first zone of aeration is characterized by the descending water movements of infiltration and inflow; the so-called suspended karstic waters are also in this zone. The second zone is the zone of seasonal fluctuations of karstic waters. The third zone is the zone of full saturation where the drainage is governed by the local drainage network underground. The fourth or the last zone is the zone of deep circulation where groundwaters move in the direction of remote outlets and where there is no direct influence of local drainage. (Gabriel-USGS)
W70-07086

NONSTEADY FLOW TO A WELL IN AN INFINITE ANISOTROPIC AQUIFER,
Geological Survey, Washington, D.C.
Istravros S. Papadopulos.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 21-31, 1967. 5 fig, 1 tab, 6 ref.

Descriptors: *Groundwater movement, *Aquifers, *Water level fluctuations, Anisotropy, Isotropy, Hydrologic data, Hydrologic properties, Water wells, Transmissivity, Analysis, Mathematical studies, Mathematical models, Discharge (Water), Discharge measurement, Analog models.
Identifiers: *Aquifers testing, Pumping tests (Aquifers).

Well flow equations presently used in the analysis of pumping tests and the prediction of water levels have been derived under the assumption that aquifers are isotropic. These existing equations are not applicable to anisotropic aquifers such as fractured rocks. In this paper, an equation is derived for the drawdown distribution around a well discharging at a constant rate from an infinite anisotropic aquifer. Drawdowns computed by this equation are compared and found to be in good agreement with those observed in an electric-analog model constructed for this purpose. It is shown that pumping test data from a minimum of three observation wells can be analyzed to obtain the components of the transmissibility tensor along an arbitrarily chosen set of axes, and that these components, in turn, can be used to determine the principal transmissibilities and the orientation of the principal axes. The method is illustrated with an example. (Gabriel-USGS)
W70-07087

STATISTICAL ASPECT OF THE PROBLEM OF PERMEABILITY OF FISSURED ROCKS,
M. V. Rats, and S. N. Chernyashov.
French summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 227-236, 1967. 5 fig, 1 tab.

Descriptors: *Statistical methods, *Statistical models, *Aquifers, *Permeability, *Joints (Geology), *Fissures (Geology), Mathematical studies, Parametric hydrology, Heterogeneity, Homogeneity, Geographical regions, Deformation, Erosion, Sandstones, Igneous rocks, Probability, Karst, Geology.
Identifiers: Jointed rocks.

The physical laws governing the distribution and homogeneity fissures and permeability in rocks were investigated statistically. Mathematical criteria were applied to separate the homogeneous and heterogeneous media and to set limits for the application of permeability concepts. Several examples of the application of statistical methods for the analysis of fissures and permeability parameters are given over wide geographical and geological ranges. (Gabriel-USGS)
W70-07088

THE EFFECT OF KARST ON THE REGULARITIES OF GROUNDWATER FLOW FORMATION,
Moscow State Univ. (USSR).
B. I. Koudelin, and V. P. Karpova.
Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), Interna-

ional Association of Scientific Hydrology, Publication No 73, p 208-212, 1967.

Descriptors: *Groundwater, *Karst, *Water circulation, Flow characteristics, Topography, Dolomite, Limestones, Erosion, Runoff, Geology, Absorption, Hydrologic properties, Streamflow, Rivers, River basins, Hydrographs, Hydrograph analysis.
Identifiers: *USSR, Urals, Crimea.

A brief review is given of the characteristics of groundwater flows in the karstic regions of the USSR. Karst leads to the intensification of a groundwater flow. Karst interrupts the smooth zonal character of the distribution of groundwater and flow values of the area. Wide fluctuations of groundwater flow and surface runoff are observed within karstic regions. Karst leads to the redistribution of groundwater flows into rivers within relatively small areas. The large values of the moduli and coefficients of groundwater flow and base flow in karstic regions are due not only to highly favorable conditions for precipitation absorption and surface runoff by karstic rocks, but also to the peculiar features of the karstic water regime noted for its vigorous, turbulent and rapid groundwater movement. The type of groundwater flow in karstic massifs is often similar to that of a streamflow regime. Karstic rock massifs are noted for relatively limited water storage, as compared with poorly-indurated rocks. (Gabriel-USGS)
W70-07089

HYDROLOGY OF SEBOU-BETH KARSTIC ZONE OF MOROCCO (IN FRENCH),
Water Resources Service (Morocco).
R. Hazan, and D. Lazarevitch.
English summary. Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 275-292, 1967. 12 fig, 1 tab.

Descriptors: *Karst, Hydrologic properties, *Groundwater basins, Runoff, Drainage, Permeability, Geology, Fissures (Geology), Floods, Average flow, Water resources, Sediment transport, Precipitation (Atmospheric), Hydrography, Water storage, Electric power, Silting.
Identifiers: *Morocco, Sebou-Beth basins.

Hydrologic characteristics of the Sebou-Beth karstic and impermeable basins were investigated on the basis of geological and hydrological data recorded from 1935 to 1963. Evapotranspiration plays an important part in the karstic Sebou-Beth basin by controlling to some extent the annual discharge, runoff, and groundwater runoff; the karstic zone plays the role of a dam and a reservoir. It is suggested that the use of hydroelectric power may be considered to have promise. (Gabriel-USGS)
W70-07090

THE BASIC HYDROLOGIC CHARACTERISTICS OF THE KARST RIVER LJUBLJANICA,
Hydrometeorological Inst., Ljubljana (Yugoslavia).
For primary bibliographic entry see Field 02E.
W70-07091

2G. Water in Soils

CHEMICAL CONTAMINANTS FOUND IN SURFACE AND SUBSURFACE WATER AS RELATED TO SOIL AND CLIMATIC CONDITIONS,
Maine Univ., Orono.
For primary bibliographic entry see Field 05A.
W70-06756

AN OSMOTIC METHOD FOR STUDYING THE SUCTION/MOISTURE CONTENT RELATIONSHIPS OF POROUS MATERIALS,
Rothamsted Experimental Station, Harpenden (England).
D. T. Pritchard.
Journal of Soil Science, Vol 20, No 2, p 374-383, September 1969. 10 p, 10 fig, 9 ref.

Descriptors: *Osmosis, *Moisture content, *Moisture tension, Soil water movement, Porosity, Permeability, Soil structure, Porous media, Membranes, Osmotic pressure.
Identifiers: Moisture content-tension relations.

Zur's osmotic method was simplified by placing 2 g particulate samples in 6.5 mm diam sacs made of semipermeable membrane tubing and suspending these in solutions of polyethylene glycol (PEG), molecular weight approx. 20,000. Moisture content was measured daily by weighing the sacs. PEG solutions of low pF were calibrated by hanging sacs containing water in them, and observing the difference in height of the liquid surfaces at equilibrium. The range was thus extended from pF 3.0-4.2 to pF 1.5-4.1. Wetting over the whole range takes 8 days and drying, from saturation, 16 days. Six polythene boxes (each holding 3.25 liter of PEG) used simultaneously, give the equivalent of wetting curves for 24 samples per day. In the isopiestic method, used for comparison over the range pF 3.5-4.0, nickel crucibles containing 1 g samples were partly immersed in control solutions of sodium chloride, in vacuum desiccators, in a temperature controlled double water-bath. (Knapp-USGS)
W70-06768

A STEADY-STATE METHOD FOR DETERMINING DIFFUSION COEFFICIENTS IN SOIL,
Oxford Univ. (England). Soil Science Lab.
P. B. Tinker.
Journal of Soil Science, Vol 20, No 2, p 336-345, September 1969. 10 p, 4 fig, 1 tab, 15 ref.

Descriptors: *Diffusivity, *Cations, *Soil chemistry, Ion transport, Soil chemical properties, Laboratory tests, Ion exchange, Electrolytes.
Identifiers: Soil diffusivity.

A simple method for determining steady-state diffusion coefficients of cations in soil with cation exchange papers as sources and sinks may be used at a range of mositure contents. It was tested on the inter-diffusion of Ca and Mg in a Coral Rag clay soil. Sectioning and analysis of the soil after the steady state was reached gave a plot of composition with distance along the cell which was similar to the curved Ca-Mg exchange isotherm, and indicated that nearly all the flux was through the liquid phase. Values of the tortuosity factor could therefore be found. There were indications that bicarbonate ions were formed and increased the flux in some experiments. Transient-state diffusion coefficients were measured in the same experiments, and agreed fairly well with the steady-state results. (Knapp-USGS)
W70-06769

EFFECTS OF ADSORBED CATIONS ON PHYSICAL PROPERTIES OF TROPICAL RED EARTHS AND TROPICAL BLACK EARTHS: I. PLASTIC LIMIT, PERCENTAGE STABLE AGGREGATES, AND HYDRAULIC CONDUCTIVITY,
Hawaii Agricultural Experiment Station, Honolulu.
S. Ahmed, L. D. Swindale, and S. A. El-Swaify.
Journal of Soil Science, Vol 20, No 2, p 255-268, September 1969. 14 p, 3 fig, 4 tab, 24 ref.

Descriptors: *Soil chemistry, *Soil structure, *Hydraulic conductivity, *Electrolytes, *Clay minerals, Sodium, Potassium, Calcium, Magnesium, Water chemistry, Soil chemical properties, Soil texture, Soil types, Plasticity, Atterberg limits, Hawaii.
Identifiers: Tropical soils.

Similar relative effects were obtained for plastic limits, percentage stable aggregates, and hydraulic conductivities when a tropical red earth, consisting predominantly of kaolin and iron oxide, and a tropical black earth consisting predominantly of montmorillonite, were saturated with Ca, Mg, K, or Na ions or combinations of these. Plastic limits were independent of the nature of the saturation cations, but were significantly dependent upon clay type. Percentage stable aggregates of artificially prepared aggregates and hydraulic conductivity were affected by the 4 cations in the order Ca Mg K Na and were also significantly affected by clay type. Combinations of the 4 cations generally gave intermediate effects with Ca-saturated soils more susceptible to deterioration by K or Na than Mg-saturated soils. The results confirm the generally deleterious effect of Na ions and show that K ions have effects similar to Na on the properties investigated. They suggest that heavy potash fertilization without liming may lead to structural deterioration of these soils. (Knapp-USGS)
W70-06771

INFLUENCE OF GRAVEL LAYERS ON SOIL MOISTURE CONTENT AND FLOW,
Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
John C. Corey, and J. Henry Horton.
Available from Clearinghouse as DP-1160 at $3.00 in paper copy and $0.65 (microfiche). Savannah River Laboratory Report DP-1160, E. I. Du Pont De Nemours and Co, Aiken, S C, May 1969. 23 p, 9 fig, 10 ref. USAEC Contract AT (07-2)-1.

Descriptors: *Leaching, *Soil water movement, *Percolation, *Path of pollutants, *Radioactive waste disposal, Silts, Sands, Gravels, Radioactive wastes, Groundwater movement, Saturated flow, Unsaturated flow, Laboratory tests, Model studies, Hydraulic models, Waste disposal.
Identifiers: Gravel lenses.

Three experiments were used to determine the influence of a gravel lens on soil water near the lens and the flow paths taken by the water. Gravel lenses cannot divert percolating rainwater 2 meters during periods of prolonged rain. Four-meter diversions would be required to protect solid radioactive waste contained in large burial trenches. However, the existence of diversion suggests that the contaminated interiors of individual pipes and vessels in such trenches are immune to leaching. The small openings in this equipment permit the diversion of percolating water around the vessel as long as the interior of the vessel remains free of soil. Laboratory studies of infiltration, drainage, and rewetting confirmed that sandy loam and sandy clay soil have a greater capacity to hold water when they are above a gravel layer. After drainage, 85 cm of soil can retain water equal to or greater than the precipitation that infiltrates during an average rain. (Knapp-USGS)
W70-06779

UTILIZATION AND MANAGEMENT OF WATER IN THE ARID ZONES OF MEXICO (IN SPANISH),
Instituto Tecnologico y de Estudios Superiores de Monterrey (Mexico). Departmento de Suelos e Irrigacion.
For primary bibliographic entry see Field 02I.
W70-06825

AN EXPERIMENTAL INVESTIGATION OF RUNOFF PRODUCTION IN PERMEABLE SOILS,
McGill Univ., Montreal (Quebec).
Thomas Dunne, and Richard D. Black.
Water Resources Research, Vol 6, No 2, p 478-490, April 1970. 13p, 10 fig, 4 tab, 12 ref.

Descriptors: *Rainfall-runoff relationships, *On-site tests, *Model studies, *Subsurface runoff, *Overland flow, Infiltration, Groundwater movement, Soil water movement, Simulated rainfall, Antecedent precipitation.
Identifiers: Experimental watersheds.

In an area of low intensity rainfall and permeable soils, three hillside plots were instrumented for a study of runoff-producing mechanisms. Runoff from the plots was measured at the ground surface, the base of the root zone, and in the zone of perennial groundwater seepage. Data on soil moisture, water-table elevation, and piezometric head were collected during both natural and artificial storms. When the infiltration capacity of the soil exceeded the rainfall intensities, overland flow did not occur. Although soils and topography were those generally thought to be conducive to subsurface stormflow, the runoff produced by this mechanism was too small, too late, and too insensitive to fluctuations of rainfall intensity to add significantly to stormflow in the channel at the base of the hillside. When the water table rose to the surface of the ground, overland flow was generated on small areas of the hillside. Only when this overland flow occurred were significant amounts of stormflow contributed to the channel by the hillside. The return periods of storms that would produce such overland flow were found to be very large. (Knapp-USGS)
W70-06996

OBSERVATIONS ON THE GROWTH OF NEEDLE ICE,
Canterbury Univ., Christchurch (New Zealand).
For primary bibliographic entry see Field 02C.
W70-07005

COMPARISON OF SOLUTIONS OF A NONLINEAR DIFFUSION EQUATION,
Cornell Univ., Ithaca, N.Y.
Wilfried Brutsaert, and Richard N. Weisman.
Water Resources Research, Vol 6, No 2, p 642-644, April 1970. 3 p, 1 fig, 1 tab, 7 ref.

Descriptors: *Diffusion, *Equations, *Mathematical studies, Mathematical models, Infiltration, Percolation, Numerical analysis.
Identifiers: Nonlinear diffusion.

Four solutions of a general nonlinear diffusion equation are given. A numerical analysis serves as reference for one series solution and for two more simple approximate solutions. The accuracy of the methods is discussed and presented graphically; the results of the numerical analysis are given in tabular form. It was found that the usefulness of the two approximate solutions lies in their mathematical simplicity and the accuracy with which they describe infiltration. (Knapp-USGS)
W70-07010

A MODEL OF SURFACE CRUSTING AND INFILTRATION OF BARE SOILS,
Technion - Israel Inst. of Tech., Haifa; and Ministry of Agriculture.
Ido Seginer, and Joseph Morin.
Water Resources Research, Vol 6, No 2, p 629-633, April 1970. 5 p, 6 ref.

Descriptors: *Infiltration, *Impact (Rainfall), *Soil compaction, *Permeability, *Mathematical models, Soil structure, Soil moisture, Soil water movement, Soil surfaces, Surface sealing.
Identifiers: Soil surfacr crusting.

An infiltration equation was derived on the assumption that a drop upon impact with the soil compacts a small area. The size of this area is characteristic of the drop and the soil properties. Extensions of this model can treat spectrums of drops and variations of rainfall characteristics with time. The model applies to initially saturated homogeneous soil columns and leads to the conclusion that the reduction of infiltration capacity is not directly related to time but rather to the number of drops that hit the surface. The effect of the depth of the soil column on the final infiltration capacity is such that the deeper it is, the higher the final infiltration capacity, approaching a limit, which depends on the properties of the crust, not of the subsoil. It is suggested that comparisons between infiltration experiments in columns be made on the basis of the intrinsic value of the limiting infiltration capacity. (Knapp-USGS)
W70-07012

SOIL MOISTURE IN RELATION TO VEGETATION DISTRIBUTION IN THE MOUNTAINS OF NORTHERN IDAHO,
Washington State Univ., Pullman.
R. Daubenmire.
Ecology, Vol 49, No 3, p 431-438, Late Spring 1968. 3 fig, 2 tab, 13 ref.

Descriptors: *Soil moisture, *Vegetation, *Ecological distribution, *Mountains, *Idaho, Slopes, Altitude, Environmental effects, Distribution patterns, Soil-water-plant relationships, Soil water, Climatic zones, Habitat, Biomes, Terrestrial habitats, Moisture stress, Moisture deficit, Succession, Climax, Growth stages, Drought tolerance, Plant physiology, Aestivation, Xerophytes, Arid lands, Semiarid climates, Pine trees, Fir trees, Fescues, Wheatgrasses.
Identifiers: *Vegetation zones, *Soil drought, *Soil moisture regimes, Growth water.

Studies in northern Idaho showed that in summer soil drought was earliest and most intense on basal plains of mountains, but intensity decreased in higher forest associations. This would appear to substantiate previous data indicating that above a certain point in the synecologic series, soil drought is of minor importance in explaining community differentiation. Climax vegetation dominated by Douglas-fir, ponderosa pine, Idaho fescue, or bearded bluebunch wheatgrass suffered regular and severe soil drought. In contrast, climax species such as alpine fir, Pacific hemlock, and giant arborvitae showed little or no soil drought at season of maximum dryness. However, in densely forested mesophytic areas, the early stages of secondary succession were occasionally characterized by intense soil drought. Also, fescue and wheatgrass were found on high forested mountain slopes in local areas of soil drought similar to their habitat in the basal plains. These data for northern Idaho show clearly that soil moisture conditions can be predicted more reliably from climax conditions of vegetation types than by elevation above sea level. (Carr-Arizona)
W70-07051

2H. Lakes

DISTRIBUTION OF MAJOR, MINOR, AND TRACE CONSTITUENTS IN UNCONSOLIDATED SEDIMENTS FROM SOUTHERN LAKE MICHIGAN,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 02J.
W70-06748

LAKESHORE TWO-DIMENSIONAL DISPERSION,
Ontario Water Resources Commission, Toronto. Great Lakes Water Quality Surveys Program.
M. D. Palmer, and J. B. Izatt.
Ontario Water Resources Commission, Canada Great Lakes Surveys Program, March 26, 1970. 29 p, 11 fig, 5 tab, 9 ref.

Descriptors: *Lakes, *Currents (Water), *Dispersion, Markov processes, Stochastic processes, Instrumentation, Current meters, Great Lakes, Diffusion, Dye releases, Tracking techniques, Statistical methods.
Identifiers: Lakeshore dispersion.

Hourly two-dimensional dispersion characteristics are determined from recording current meter histories for the nearshore areas on Lake Erie and Lake Ontario. The current histories were obtained in areas within 4 km of shore and at water depths of 10 to 14 meters during May to November 1968. A Markov chain process was applied to hourly current readings. Three different formulations of the stochastic process were tested prior to the selection of the most reliable one. The results obtained in applying the developed technique compare favorable with results obtained from conventional dye injection and drogue studies. (Knapp-USGS)
W70-06762

AN ANALYSIS OF CURRENT MEASUREMENTS IN LAKE MICHIGAN,
New York Univ., Bronx. Geophysical Sciences Lab.; and Columbia Univ., Dobbs Ferry, N. Y. Hudson Labs.
Frank D. Malone.
Journal of Geophysical Research, Vol 73, No 22, p 7065-7081, November 15, 1968. 17 p, 13 fig, 3 tab, 23 ref. ONR Contracts PH86-66-17, Contract Nonr 285 (57) and Nonr 266 (84).

Descriptors: *Currents (Water), *Lake Michigan, *Statistical methods, *Data processing, Frequency analysis, Fourier analysis, Lakes, Limnology, Water circulation.
Identifiers: Spectral analysis, Cross-spectral analysis.

Current meter records, collected from Lake Michigan during the Great Lakes-Illinois River Basins project, are studied using harmonic, spectral, and cross-spectral analysis techniques. Major peaks in the velocity spectra are located near the local inertial frequency during the thermocline season. Cross-spectra between the velocity components at different depths yield high coherences (0.9) near the inertial frequency and show that the velocity components are approximately 180 deg out of phase above and below the thermocline. The current meter records from the mouth of Green Bay and the Straits of Mackinac are dominated by periods of 12 and about 50 hours, respectively. (Knapp-USGS)
W70-06794

CHEMICAL CHARACTERISTICS OF LAKE ONTARIO,
Bureau of Commercial Fisheries, Ann Arbor, Mich. Biological Lab.
For primary bibliographic entry see Field 02K.
W70-06966

PHYTOPLANKTON,
Freshwater Biological Association, Ambleside (England).
J. W. G. Lund.
Eutrophication: Causes, consequences, correctives, p 307-330. Printing and Publishing Office, National Academy of Sciences, Washington, DC, 1969. 4 fig, 2 tab, 45 ref.

Descriptors: *Phytoplankton, Eutrophication, Nutrients, Diatoms, Phosphates, Nitrates, Silicates, Chlamydomonas, Fertilizers, Cyanophyta, Turbidity, Color, Chlorophyta, Sewage, Meromixis, Lakes, Stratification.
Identifiers: Asterionella formosa, Aphanizomenon flos-aquae, Cyclotella pseudostelligera, Staurastrum chaetoceros, Fragilaria crotonensis, Anabaena solitaria, Stephanodiscus hantzschii, Achnanthes, Nitzschia, Synedra, Oscillatoria, Cryptomonas, Ceratium, Algal blooms, Lake Windermere (England), English Lake District.

Supportive data indicate that stratification of lakes similar to England's Windermere is advantageous in reducing algal problems. Lake nutrients are lost in deposits, outflow or recycled; the vital factor in eutrophication is the contribution of nutrients from the drainage area. Production of a permanent hypolimnion, is advocated to reduce fertility in meromictic lakes, assisted with the use of flocculants and adsorbents; the material so removed would be retained in the hypolimnion as the stronger the meromixis the lower quantity of nutrients will be recycled when thermal stratification breaks down. In contrast to this view, the experience of the Metropolitan Water Board of London is cited, when reservoirs had their potential

mmer stratification reduced by jet-type inlets or tial flow pumps. Overturning a lake in summer sults in lesser algal production, judged by trans- arency and absence of blooms. (See also W70-3975). (Auen-Wisconsin)
/70-06976

EW SMALL LAKE LAW--OPEN SPACE AND ECREATION VERSUS FILLING AND BUILD-NG,
or primary bibliographic entry see Field 06E.
/70-07103

I. Water in Plants

/ATER USE, ADAPTABILITY, AND CHEMI-AL COMPOSITION OF GRASSES SEEDED AT IGH ELEVATIONS,
orest Service (USDA), Logan, Utah. Intermoun- in Forest and Range Experiment Station.
or primary bibliographic entry see Field 03B.
/70-06775

IUTRIENT LOSS ACCELERATED BY CLEAR-UTTING OF A FOREST ECOSYSTEM,
'ale Univ., New Haven, Conn.; Dartmouth Coll., lanover, N. H.; Geological Survey, Washington,). C.; and Forest Service (USDA), Durham, N. H.
'or primary bibliographic entry see Field 04C.
/70-06796

URVIVAL OF WINTER ANNUALS IN THE IORTHERN MOJAVE DESERT,
California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
anice C. Beatley.
Ecology, Vol 48, No 5, p 745-750, Late Summer 1967. 3 tab, 15 ref.

Descriptors: *Desert plants, *Deserts, *Nevada, *Soil moisture, *Mortality, Arid climates, Arid ands, Xerophytes, Environment, Moisture deficit, Germination, Plant growth, Growth stages, Vegeta- ion establishment, Mature growth stage, Life cy- les, Winter, Precipitation (Atomospheric), Soil- water-plant relationships.
Identifiers: *Annuals, *Seedlings, *Mojave Desert, Moisture regime, Stem elongation, Growing season, Plant survival, Seedlings.

In 1963-64 the population of Mojave Desert winter annuals in three southern Nevada drainage basins was sampled following early autumn germination. Only 38% of the plants survived to maturity, with death occurring in the early spring at beginning of stem elongation. Although the data showed no pronounced precipitation deficiency during the growing season, plant mortality appeared to be the result of insufficient soil moisture. Due to the rapid increase in plant volume at this period, water demands of all seedlings could not be met. In 1965 mortality of spring-germinating winter annuals was studied. Survival to maturity was much higher (60%) for these plants with their shorter life cycle than for the fall-germinating species. Plant mortality for the spring-germinating population was not attributable to moisture deficit. It would appear that in most seasons the majority of winter annual seedlings do not survive to maturity. (Carr-Arizona)
W70-06808

ARTIFICIAL SELECTION FOR SEEDLING DROUTH TOLERANCE IN BOER LOVEGRASS (ERAGROSTIS CURVULA NEES),
Arizona Univ., Tucson. Dept. of Agronomy; and Agricultural Research Service. Tucson, Ariz. Crops Research Div.
L. Neal Wright, and Gilbert L. Jordan.
Crop Science, Vol 10, No 1 p 99-102, January-February 1970. 1 fig, 2 tab, 5 ref.

Descriptors: *Range grasses, *Forage grasses, *Drought tolerance, *Crop response, Environment, Environmental effects, Moisture stress, Moisture deficit, Growth chambers, Grasses, Arid lands, Semiarid climates, Southwestern U.S., Arizona, On-site investigations, Frequency analysis.
Identifiers: *Boer lovegrass, *Lehmann lovegrass, *Artificial selection, *Seedling drought tolerance, *Survival rates, Stand density.

A program-controlled environment was used for artificial selection and study of 16 sources of boer lovegrass. The plants were stressed for seedling drought tolerance and the progeny of the surviving 216 plants were evaluated. Experimental 3-17, which showed three times the drought tolerance of check cultivar A-84, had a significantly higher survival rate than other selections. The extreme selections were re-evaluated under artificial conditions but the relative rankings did not change. Experimental 3-17, check cultivar A-84, and A-68 lehmann lovegrass were then grown in their natural environment. The rangeland seeding tests took place in southeastern Arizona in 1967 and 1968. Experimental 3-17 obtained a stand density equal to that of lehmann lovegrass and superior to that of the check cultivar. These studies indicate that controlled environments can be used for the consistant evaluation and selection of seedlings. (Carr-Arizona)
W70-06809

MEDITERRANEAN ECOSYSTEMS AND VEGETATION TYPES IN CALIFORNIA AND ISRAEL,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Z. Naveh.
Ecology, Vol 48, No 3, p 445-459, Late Spring 1967. 7 fig, 4 tab, 50 ref.

Descriptors: *Ecosystems, *Environmental effects, *Environment, *California, *Semiarid climates, Grasslands, Plant groupings, Vegetation establishment, Climates, Climatic zones, Geographical regions, Climatic data, Succession, Invasion, Soils, Soil types, Oak trees, Chaparral, Rainfall, Precipitation (Atmospheric), Wet seasons, Dry seasons, Weather patterns, Moisture stress, Rainfall disposition.
Identifiers: *Mediterranean ecosystems, *Israel, *Vegetation types, Biotic history, Moisture regime.

Mediterranean vegetation types of Israel and California were compared from a dynamic and holistic viewpoint. When a comparison was made of climate, soils, vegetation, and biotic history of these two ecosystems, closest ecological equivalence occurred between vallonea oak grassland savanna of Israel and blue oak grassland savanna of California. Amount of rainfall, monthly distribution, and rainfall variability were compared between Auberry, California, and Nazareth, Israel. These two sites showed similar annual averages and variability of precipitation. In California, however, the rain season was longer, leading to greater unreliability in moisture regime and increased probability of moisture stress. These factors produce a more erratic and unfavorable plant climate. (Carr-Arizona)
W70-06810

INFLUENCE OF DROUGHT AND GRAZING ON MORTALITY OF FIVE WEST TEXAS GRASSES,
Texas Tech Univ., Lubbock. International Center for Arid and Semi-Arid Land Studies.
Thadis W. Box.
Ecology, Vol 48, No 4, p 654-656, Summer 1967. 3 tab, 15 ref.

Descriptors: *Drought, *Grazing, *Mortality, *Texas, *Forage grasses, Grama grasses, Switchgrass, Forages, Range grasses, Semiarid climates, Drought resistance, Drought tolerance, Plant physiology, Soil types.
Identifiers: *Grazing effects, *Sideoats grama, *Sand lovegrass, *Indiangrass, *Silver bluestem, Growth forms, Clones.

This study examined combined effects of drought and grazing on grasses growing in grazed and ungrazed pastures of Brownfield fine sand, eroded phase. The experiment took place in West Texas during a four-year drought (1962-1965). Percentage of dead clones was higher (P .01) among grazed plants than among ungrazed plants, even though grazing pressure was light. No ungrazed plants of silver bluestem, sideoats grama, switchgrass, or Indiangrass were completely dead and only 3% of the sand lovegrass died. The respective percentages for the grazed pasture were 13%, 10%, 54%, 37%, and 40%. Ungrazed plants exhibited normal or hollow growth forms, but grazed plants showed only a strip of live material along one edge. The amount of dead material in a clone when compared with clone size correlated negatively (P .01) for ungrazed plants and positively (P .01) for grazed sand lovegrass and sideoats grama. (Carr-Arizona)
W70-06811

WATER REQUIREMENTS IN STRAINS OF VINE-MESQUITE (PANICUM OBTUSUM H. B. K.),
New Mexico State Univ., University Park. Dept. of Agronomy.
Vincent K. Weng, and Ferdinand A. Quinones.
Crop Science, Vol 9, No 4, p 412-415, July-August 1969. 4 tab, 9 ref.

Descriptors: *Water requirements, *Water utilization, *Forage grasses, *Range grasses, *Semiarid climates, Arid lands, Moisture stress, Water conservation, Erosion, Crop production, Crop response, Plant growth, Growth stages, Consumptive use, Transpiration, Correlation analysis, Grasses, Greenhouses, Least squares method.
Identifiers: *Water-use efficiency, *Vine-mesquite.

Nine strains of vine-mesquite were grown in a greenhouse and their water requirements studied. The experiment was conducted over a period of 126 days, during which time 3 herbage clippings were made. Plant water requirements (the ratio of transpiration to herbage yield) were determined. Transpiration, dry herbage yield, and water requirement showed no statistical difference among strains for any growth period or for the experiment as a whole. However, the 9 strains showed significant differences in transpiration throughout the study. Despite a large, significant negative genetic correlation between herbage yield and water requirement, there were no significant differences among strains in these traits. This would indicate that high herbage yield is not a reliable guide in selection of low water-use strains of vine-mesquite. (Carr-Arizona)
W70-06812

SOME ENZYME AND PROTEIN CHANGES ASSOCIATED WITH WATER STRESS IN WHEAT LEAVES,
Oklahoma State Univ., Stillwater. Dept. of Botany.
Charles A. Stutte, and Glenn W. Todd.
Crop Science, Vol 9, No 4, p 510-512, July-August 1969. 3 fig, 14 ref.

Descriptors: *Enzymes, *Protein, *Moisture stress, *Wheat, *Leaves, Plants, Plant physiology, Crops, Organic compounds, Iron, Electrophoresis, Water loss, Wilting, Droughts, Moisture availability, Moisture content, Amino acids.
Identifiers: Peroxidase, Lactic dehydrogenase.

Wheat leaves were studied under varying degrees of moisture stress in order to determine enzyme changes in their soluble proteins. Using acrylamide gel electrophoresis, changes in enzyme patterns were compared with changes in total protein and iron-containing protein. Under conditions of severe wilting lactic dehydrogenase was found in fewer bands, while iron-containing proteins not only ap-

peared in a greater number of bands, but also increased in total quantity. As water stress increased some peroxidase bands disappeared and new ones appeared. Total peroxidase activity per unit of protein increased as wilting progressed, but the amount of total soluble protein declined drastically. (Carr-Arizona)
W70-06813

WATER-USE EFFICIENCY AND ITS ASSOCIATION WITH SEVERAL CHARACTERISTICS OF BLUE PANICGRASS (PANICUM ANTIDOTALE RETZ.) CLONES,
Arizona Univ., Tucson. Dept. of Agronomy; and Agricultural Research Service, Tucson, Ariz. Crops Research Div.
A. K. Dobrenz, L. Neal Wright, M. A. Massengale, and W. R. Kneebone.
Crop Science, Vol 9, No 2, p 213-216, March-April 1969. 3 fig, 4 tab, 14 ref.

Descriptors: *Forage grasses, *Water utilization, *Efficiencies, *Plant morphology, *Plant physiology, Arid lands, Southwest U.S., Environmental effects, Drought tolerance, Soil moisture, Moisture stress, Grasses, Soil-water-plant relationships, Consumptive use, Leaves, Crop production, Crop response, Growth stages, Transpiration, Amino acids, Proteins.
Identifiers: *Water-use efficiency, *Blue panicgrass, *Clones, Vascular bundles, Leaf anatomy, Lysine, Histidine, Arginine, Glysine, Alanine, Seedlings.

An experiment was designed to investigate water-use efficiency of blue panicgrass in relation to its physiological and morphologican characteristics. A controlled environment was used to simulate the arid climatic conditions of the U.S. Southwest. Clones previously determined as either seedling drought tolerant or seedling drought susceptible were tested under three levels of soil moisture stress. Water-use efficiency was significantly associated with fresh weight, dry weight, total protein, and the amino acids alanine, arginine, glycine, histidine, and lysine. There was also a non-significant association between water-use efficiency and seedling drought tolerance. The most efficient water users had more vascular bundles in the leaves than the least efficient water users. (Carr-Arizona)
W70-06814

STOMATE DENSITY AND ITS RELATIONSHIP TO WATER-USE EFFICIENCY OF BLUE PANICGRASS (PANICUM ANTIDOTALE RETZ.),
Arizona Univ., Tucson. Dept. of Agronomy; and Agricultural Research Service, Tucson, Ariz. Crops Research Div.
A. K. Dobrenz, L. Neal Wright, A. B. Humphrey, M. A. Massengale, and W. R. Kneebone.
Crop Science, Vol 9, No 3, p 354-357, May-June 1969. 2 fig, 5 tab, 11 ref.

Descriptors: *Forage grasses, *Water utilization, *Efficiencies, *Stomata, *Transpiration, Evapotranspiration, Plant morphology, Plant physiology, Arid lands, Southwest U.S., Drought tolerance, Grasses, Leaves, Consumptive use, Soil moisture, Crop response.
Identifiers: *Blue panicgrass, *Water-use efficiency, *Stomate density, Clones, Seedlings, Culms.

Six clones of blue panicgrass from three different sources of germ plasm were selected for use in a study of the relationship between stomate density and water-use efficiency. The clones represented a wide range of previously-determined seedling drought tolerance. Stomate density was calculated from silicone rubber impressions taken on abaxial and adaxial leaf surfaces. Impressions were taken from the base, middle, and tip of each leaf and leaves were chosen from the base, middle and top of each culm. Stomate density ranged from 78 to 165 per square mm. Leaves at the base and middle of the culm had significantly higher stomate density than those adjacent to the inflorescence. Stomate density did not differ for the three positions on the leaf. There was a non-significant correlation between water-use efficiency and stomate density, with drought tolerant clones having fewer stomates per unit area. (Carr-Arizona)
W70-06815

CORN YIELDS, SOIL TEMPERATURE, AND WATER USE WITH FOUR TILLAGE METHODS IN THE WESTERN CORN BELT,
Agricultural Research Service, Brookings, S. Dak. Corn Belt Branch; and South Dakota Agricultural Experiment Station, Brookings.
Tamlin C. Olson, and LaVern S. Schoeberl.
Agronomy Journal, Vol 62, No 2, p 229-232, March-April 1970. 1 fig, 5 tab, 11 ref.

Descriptors: *Crop production, *Corn, *Water utilization, *Corn Belt, *Cultivation, Semiarid climates, South Dakota, Soil temperature, Plant growth, Rainfall, Erosion, Soil erosion, Runoff, Water loss, Water conservation, Soil water, Soil moisture, Planting management.
Identifiers: *Plowing, *Listing, *Till planting, *Wheeltrack planting.

Corn yield and growth characteristics were compared for 4 tillage systems during crop years 1965, 1966, 1967 and 1968. The 4 methods under study were conventional plowing, wheeltrack planting, till planting, and listing. Although the difference was not significant between the four systems, the three reduced-tillage methods tended to have higher average grain yields. Rainfall during the four test years was below normal, so that the runoff-conserving characteristics of the reduced-tillage systems had little influence on the amount of water available to growing corn. Nonetheless, the experimental results show that the reduced-tillage methods can be used in the Corn Belt without sacrificing grain yield. These systems are also more economical and better able to protect against soil erosion and runoff. (Carr-Arizona)
W70-06817

EFFICIENCY OF WATER USE AND SEEDLING DROUGHT TOLERANCE OF BOER LOVEGRASS, ERAGROSTIS CURVULA NEES,
Arizona Univ., Tucson. Dept. of Agronomy; and Agricultural Research Service, Tucson, Ariz. Crops Research Div.
L. Neal Wright, and A. K. Dobrenz.
Crop Science, Vol 10, No 1, p 1-2, January-February 1970. 2 tab, 8 ref.

Descriptors: *Range grasses, *Water utilization, *Efficiencies, *Drought tolerance, *Arid lands, Arid climates, Semiarid climates, Grasses, Consumptive use, Natural use, Transpiration, Crop response, Plant physiology, Growth stages, Environment, Environmental effects.
Identifiers: *Boer lovegrass, *Seedlings.

An experiment was established to determine the water-use efficiency of boer lovegrass and compare it with seedling drought tolerance. Lovegrass selections chosen to represent extremes of drought tolerance were studied in greenhouse and growth chamber environments in Tucson, Arizona. It was found that seedlings had lower water-use efficiency than mature plants, but relative ranking of selections did not vary with stage of growth. The most drought tolerant seedlings were the least efficient water users. An r = .80 correlation coefficient indicated significant negative association between seedling water-use efficiency and seedling drought tolerance. This association was also valid for mature plant water-use efficiency and seedling drought tolerance. Water-use efficiency was measured as the number of units of water transpired per unit of dry matter produced. (Carr-Arizona)
W70-06819

LOWER ELEVATIONAL LIMITS OF MONTANE TREES. II. ENVIRONMENT-KEYED RESPONSES OF THREE CONIFER SPECIES,
Redlands Univ., Calif. Dept. of Biology.
Robert D. Wright.
Botanical Gazette, Vol 129, No 3, p 219-226, September 1968. 3 fig, 3 tab, 13 ref.

Descriptors: *Pine trees, *Conifers, *Elevation, *Environmental effects, *Distribution patterns, Altitude, Mountains, Environment, Environmental gradient, Climate, Climatic zones, Heat resistance, Drought tolerance, Moisture stress, Soil moisture, Phenology, Growth rates, Root development, Root systems, Coniferous trees, California.
Identifiers: *Knobcone pine, *Coulter pine, *Sugar pine, *Elevation limits, Seedlings, Transpiration rates, San Bernadino Mountains.

Knobcone pine, Coulter pine, and sugar pine were studied in laboratory and field experiments. Growth tests were performed in an attempt to discover what mechanisms determined lower elevation limits of the species. In the area under study, sugar pine was found at the highest elevations, Coulter at middle elevations, and knobcone at lowest elevations. Sugar pine was quite different from knobcone and Coulter pines in many respects, such as seedling drought tolerance, seedling survival in the field, phenology of shoot and needle elongation, rooting pattern in the field, and sensitivity of diameter growth rate to low elevation. Sugar pine was found to be least drought tolerant of the species under study, followed by knobcone pine, and then by Coulter pine. The fact that the latter two species are in inverse order when compared with their elevation positions appears to indicate that past wildfires may have effected their present distribution. (Carr-Arizona)
W70-06820

ESTIMATION OF THE OSMOTIC POTENTIAL OF CITRUS SEEDLING LEAF SAP AT DIFFERENT SOIL-MOISTURE LEVELS BY MEANS OF REFRACTOMETRY AND CONDUCTIMETRY,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
H. Bielorai.
Annals of Botany, Vol 32, No 127, p 473-477, July 1968. 1 fig, 1 tab, 8 ref.

Descriptors: *Osmotic pressure, *Soil moisture, *Soil-water-plant relationships, *Refractivity, *Electrical conductance, Leaves, Plant physiology, Moisture content, Moisture deficit, Dehydration, Wilting, Turgidity, Environmental effects, Soil water, Root zone, Electrolytes, Conductivity, Citrus fruits, Oranges, Limes.
Identifiers: *Osmotic potential, *Seedlings, *Sap, *Refractometry-conductimetry method, Cryoscopy, Soluble metabolites, Soil matric potential.

Sour orange and sweet lime species were tested at various soil-moisture levels to determine the electrical conductivity and refractive index of their leaf saps. Osmotic potentials of soluble metabolites and electrolytes were estimated, respectively, from functions relating sucrose concentration and electrical conductivity to osmotic potential. The sum of these two estimates correlated significantly (r=0.957) with total osmotic potential of the leaf sap as determined by cryoscopy. Since the cryoscopic method is not accurate below the level of -6 bars, the new technique should be extremely useful for taking field measurements of changes in osmotic potential. (Carr-Arizona)
W70-06823

UTILIZATION AND MANAGEMENT OF WATER IN THE ARID ZONES OF MEXICO (IN SPANISH),
Instituto Tecnologico y de Estudios Superiores de Monterrey (Mexico). Departmento de Suelos e Irrigacion.
Jaime Leal Diaz.

English summary. Symposium on Increasing Food Production in Arid Lands, Texas Tech College, Lubbock, International Center for Arid and Semi-Arid Land Studies, Publication No 3, p 273-292, 1969. 4 fig, 6 tab, 24 ref.

Descriptors: *Water utilization, *Water management (Applied), *Mexico, *Arid lands, *Sorghum, Grains (Crops), Crop production, Crop response, Drought, Irrigation, Dry farming, Irrigation systems, Water conservation, Soil moisture, Soil water, Evaporation, Evaporation control, Transpiration, Furrows, Gravels, Stubble mulching, Moisture availability, Agriculture, Water loss, Humidity, Distance, Soil-water-plant relationships.
Identifiers: Spacing.

Researchers studied several problems of conserving and utilizing water for agriculture in arid lands in Mexico. Among the information sought was: (1) effective methods of reducing soil water loss from evaporation; (2) influence of plants on conservation of soil water; (3) importance of furrow form and width in dry farming sorghym; (4) influence of soil moisture on sorghum production. Of the possible land covers that were studied, corn stubble and gravel were the most effective in minimizing soil water evaporation, with gravel allowing better plant development than stubble. Barren ground conserved soil moisture better than vegetative cover. Six furrow widths between 60 and 210 cm were tested to determine optimum distance between furrows. Best width was 1.42 m. The most important variables influencing optimum distance were soil moisture, soil fertility, and evapotranspirative demand of the sorghum. Increasing furrow width during drought periods was beneficial for sorghum development. In the experiment with 4 systems of irrigation, data showed that a constant relationship was maintained between amount of evaporative water loss and grain production. (Carr-Arizona)
W70-06825

INFLUENCE OF SITE ON MESQUITE MORTALITY FROM 2,4,5-T,
Texas Tech Univ., Lubbock. International Center for Arid and Semi-arid Land Studies.
B. E. Dahl, Robert B. Wadley, Mel George, and Jim Talbot.
International Center for Arid and Semi-arid Land Studies, Special Report Number 33: Noxious Brush and Weed Control Research Reports--1969, p 7-17, December 31, 1969. 1 fig, 5 tab, 15 ref.

Descriptors: *Environmental effects, *Sites, *Mesquite, *Mortality, *2-4-5-T, Range management, Brush control, Weed control, Chemcontrol, Brush, Chaparral, Desert plants, Arid lands, Herbicides, Application methods, Organic compounds, Phenology, Plant growth regulators, Plant growth substances, Growth stages, Plant physiology, Habitats, Soil environment, Soil temperature, Soil moisture, Soil water, Soil texture, Calcium carbonate, Semiarid climates.
Identifiers: *Honey mesquite.

A study of various mesquite-infested sites in Texas was instituted in order to try to isolate reasons why site differences influence herbicide effectiveness. Soil temperature was found to be the single most important factor influencing response of honey mesquite to applications of 2,4,5-T. Temperatures measured at a 6-in depth were not useful, but those from an 18-in depth were found to relate directly to 2,4,5-T effectiveness. Another extremely important variable was growth stage. A mesquite tree with any degree of flower development was harder to kill than plants in other stages of growth. Soil moisture was the third most important factor, but only when in combination with other variables. Data suggested that for maximum herbicide effectiveness soil should be wet at a depth of 7-12 in below the surface and dry below 36 in. Other factors studied included calcium carbonate in the soil, air temperature, relative humidity, time of day, and soil texture. (See also W70-06827). (Carr-Arizona)
W70-06826

DIMETHYL SULFOXIDE AND CHEMICAL BUD STIMULATION TO INCREASE HERBICIDE ACTIVITY IN MESQUITE,
Texas Tech Univ., Lubbock. International Center for Arid and Semi-Arid Land Studies.
Melvin R. George, Jimmy Talbot, and B. E. Dahl.
International Center for Arid and Semi-Arid Land Studies, Special Report No 33: Noxious Brush and Weed Control Research Reports - 1969, p 18-24, December 31 1969. 3 tab, 23 ref.

Descriptors: *Mesquite, *Weed control, *Herbicides, *2-4-5-T, *Carriers, Desert plants, Chaparral, Range management, Organic compounds, Solvents, Chemcontrol, Plant growth regulators, Translocation, Bark, Phloem, Adjuvants, Penetration, Semiarid climates.
Identifiers: *DMSO (Dimethyl sulfoxide), *Tordon 225, *IAA (Indole Acetic Acid), *Honey mesquite, *Chemical bud stimulation, Synergistic effects, Gibberellic acid, Kinetin.

DMSO (dimethyl sulphoxide) was tested as a carrier for 2,4,5-T and Tordon 225 in an attempt to improve penetration and translocation of herbicides. DMSO did not increase movement of the tested herbicides through basal mesquite bark, but 2,4,5-T in DMSO was effective when applied by the frill method. This would seem to indicate that a barrier in the bark prevents movement of 2,4,5-T in DMSO. Diesel fuel effectiveness was reduced when it was combined with DMSO as a carrier for 2,4,5-T. Effectiveness of foliar application of Tordon 225 was also reduced when the herbicides was carried in DMSO. When applied alone or in water mixture DMSO was non-toxic. The experiments also indicated that the hormones IAA, gibberellic acid, and kinetin, whether alone or in DMSO, did not effect the dormant buds on mesquite seedlings. In sum, DMSO appears to have little usefulness in chemical control of mesquite. (See also W70-06828). (Carr-Arizona)
W70-06827

CORRELATION OF WEATHER VARIABLES TO MESQUITE DAMAGE BY FIRE,
Texas Tech Univ., Lubbock. International Center for Arid and Semi-Arid Land Studies.
Henry A. Wright, and Carlton M. Britton.
International Center for Arid and Semi-Arid Land Studies, Special Report No 33: Noxious Brush and Weed Control Research Reports, p 25-34, December 31 1969. 4 fig, 1 tab, 14 ref.

Descriptors: *Mesquite, *Weed control, *Burning, *Mortality, *Grasslands, Desert plants, Chaparral, Range management, Cultural control, Texas, Size, Moisture content, Humidity, Air temperature, Winds, Wind velocity, Variability, Semiarid climates, Soil temperature.
Identifiers: *Tobosa, *Controlled burning, *Weather variables, *Fuel moisture, Fine fuels, Burndown, Ignition, Southern Mixed Prairie, Soil surface temperature.

Experiments were conducted on 24 tobosa stands infested with mesquite to determine effects of various weather conditions on mesquite ignition, burndown, and mortality. Average maximum soil surface temperatures were recorded and varied from 470 F to 730 F. They did not appear to correlate significantly with any weather variable. Percentage of burndown ranged from 14.4% to 89.1%. Independent variables of air temperature, relative humidity, total fuel, and wind speed accounted for 89% of total variation in burndown. Percentage ignition varied from 33.6% to 94.9%. Using the same variables as those considered for burndown, 81% of total variation in ignition was accounted for. The best single predictor for ignition and for burndown was relative humidity, accounting for 55.8% and 46.7%, respectively, of total variation. Mortality percentages on plots ranged from 0 to 24%. Although tobosa fuel was the most important variable, no significant amount of variation in % of mortality was due to any single independent variable. Among variables tested were air temperature, fuel moisture, relative humidity, soil moisture, tobosa fuel, total fuel, wind speed, the square of the preceeding variables, and all possible interactions. Stem size was also found to influence tree mortality. Prediction equations for ignition and burndown are presented, but it must be remembered that data on which the equations are based were derived from plots on which mesquite had been previously sprayed by herbicides. (See also W70-06829). (Carr-Arizona)
W70-06828

RESPONSE OF REDBERRY JUNIPER TO SEASON OF TOP REMOVAL,
Texas Tech Univ., Lubbock. International Center for Arid and Semi-Arid Land Studies.
Joseph L. Schuster, and James George.
International Center for Arid and Semi-Arid Land Studies, Special Report No 33: Noxious Brush and Weed Control Reports - 1969, p 49-52, December 31, 1969. 3 fig, 1 tab, 3 ref.

Descriptors: *Juniper trees, *Period of growth, *Growth stages, *Vegetation regrowth, *Brush control, Weed control, Chaparral, Range management, Brush, Cultural control, Seasonal, Cutting management, Phenology, Plant growth, Size, Bark, Mortality, Rainfall, Precipitation (Atmospheric), Semiarid climates, Moisture content, Soil moisture, Texas, Soil-water-plant relationships, Plant physiology.
Identifiers: *Redberry juniper, *Top removal, Leader elongation.

An experiment on redberry juniper was undertaken in West Texas in order to determine the most effective date of top removal when attempting to prevent regrowth. Trees were randomly chosen and placed in five classes according to stem circumference. Two trees from each size class were cut near ground level on each of 19 cutting dates distributed throughout the year. Data from one year after cutting indicated that the optimum time for redberry juniper control using the top removal method was during the May-August summer period. It was also found that as tree size increased, amount of regrowth increased. Moisture content of resprouts showed no correlation to amount of regrowth. Although plant moisture content was affected by soil moisture and stage of growth, there appeared to be no relationship between percentage moisture in the plant at time of cutting and the amount of regrowth. (See also W70-06826). (Carr-Arizona)
W70-06829

FOURWING SALTBUSH SURVIVAL AFTER INUNDATION,
Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.
Earl F. Aldon.
USDA, Forest Serv. Res. Note RM-165, 2 p, 1970, 1 fig.

Descriptors: *Plant growth, *Vegetation effects, *Shrubs, *Land management , Watershed management, Grasslands, Revegetation, Vegetation establishment, Range management, New Mexico.
Identifiers: *Ground cover, *Watershed restoration.

Four-week-old fourwing saltbush transplants are subjected to high mortality if planted in areas likely to be inundated for longer than 30 hours.
W70-06846

AGE AND SPACE DISTRIBUTION OF THE DESERT SHRUB LARREA DIVARICATA,
Duke Univ., Durham, N.C. Dept. of Botany.
Michael G. Barbour.
Ecology, Vol 50, No 4, p 679-685, Summer 1969. 2 fig, 3 tab, 21 ref.

Descriptors: *Age, *Desert plants, *Distribution patterns, *Ecological distribution, *Spatial distribution, Environment, Environmental effects, Population, Biological communities, Distribution,

Germination, Shrubs, Xerophytes, Plant growth, Saline soils, Salt tolerance, Alkaline soils, Hydrogen ion concentration, Rainfall, Precipitation (Atmospheric), Deserts, Arid lands, Southwest U.S., Soil types, Soil-water-plant relationships, Toxins, Soil contamination.
Identifiers: *Creosote bush, *Age distribution, *Ecotones, Sonoran Desert, Chihuahuan Desert, Mojave Desert.

Creosote bush (Larrea divaricata Cav.) was observed throughout its range in the United States in order to determine age and spatial distribution of shrubs in Larrea stands and degree of soil changes across abrupt ecotones. Different stands of shrubs exhibited clumped, regular, or random spatial distributions. It was possible that most of the Mojave-Sonoran sites rejected by the random-quadrat method would fall in the regular distribution category. Age distribution showed significant noncentral tendencies for 90% of the stands on Mojave-Sonoran sites, but only on 43% of Chihuahuan sites. These departures from normal distribution indicate that germination and survival of Larrea are rare, especially in the more xeric Mojave-Sonoran area. Topsoil changes in pH and salinity usually did not correlate with Larrea boundaries, nor were the changes generally sufficient to affect germination and seedling growth. (Carr-Arizona)
W70-06830

STUDIES ON STRUCTURE IN PLANT COMMUNITIES; VI: THE SIGNIFICANCE OF PATTERN EVALUATION IN SOME AUSTRALIAN DRY-LAND VEGETATION TYPES,
Australian National Univ., Canberra. Research School of Biological Sciences; and Sydney Univ., (Australia). School of Biological Sciences.
D. J. Anderson, S. W. L. Jacobs, and A. R. Malik.
Australian Journal of Botany, Vol 17, No 2, p 315-322, August 1969. 4 fig, 1 tab, 24 ref.

Descriptors: *Structure, *Biological communities, *Desert plants, *Distribution patterns, *Density, Ecology, Ecological distribution, Spatial distribution, Distribution, Environment, Environmental effects, Plant populations, Grasses, Population, Soil moisture, Arid lands, Semiarid climates, Deserts, Rainfall, Drought, Vegetation, Limiting factors, Phenology, Succession, Statistical methods.
Identifiers: *Australia, *Vegetation types, *Patterns, Poissonian model, Saltbush.

Density data from a variety of Australian dry-land vegetation types provides evidence that randomness may be as frequent as patterned distributions. Strict regularity of density distribution could not be detected in the study areas, at least not with the Poissonian model that was employed. Therefore, in contrast with those persons who assume that regular distributions can be logically expected in most vegetation types, the authors feel such an assumption is logical only if (1) the factors imposing regularity are uniformly distributed, (2) the controlled plants are phenotypically uniform. The Atriplex sites that were studied are an example of an area in which the first assumption does not hold; patterns were found in microtopography, soil moisture, and associated nutrients. Neither does the second assumption hold for the Atriplex vesicaria material that was investigated. Nevertheless, there were areas under study, such as the mixed ephemeral grassland of the Simpson Desert, in which randomness probably was due to colonizing activity. The growth of that transient community following the drought-breaking rains of 1966 would conform to the traditional theories of random structure in colonizing and relict populations. (Carr-Arizona)
W70-07049

STUDIES IN THE ECOLOGY OF THE RIVERINE PLAIN; IV: BASAL AREA AND DENSITY CHANGES OF DANTHONIA CAESPITOSA GAUDICH. IN A NATURAL PASTURE GRAZED BY SHEEP,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
O. B. Williams.
Australian Journal of Botany, Vol 16, No 3, p 565-578, December 1968. 4 fig, 2 tab, 32 ref.

Descriptors: *Density, *Grazing, *Sheep, *Pastures, *Grasses, Forage, Pasture management, Range management, Grasslands, Deterioration, Ruminants, Ecology, Ecological distribution, Environment, Environmental effects, Plant growth, Growth stages, Mature growth stage, Semiarid climates, Rainfall, Precipitation (Atmospheric), Drought, Age, Distribution patterns, Plant populations, Arid lands.
Identifiers: *Australia, *Danthonia, Age distribution, Botanical composition, Gilgai, Seedlings.

Grazing treatment has demonstrated amazingly little effect on botanical composition of pasture vegetation in sheep grazing experiments in arid and semiarid regions of eastern Australia. In a further study of grazing treatments, changes in density and basal area of danthonia were measured over a 9 year period under varying grazing pressures. The grassland under study was an old man saltbush shrub steppe degraded to a short grassland through the combined actions of intermittent drought and grazing by cattle, sheep, rabbits, and red kangaroo. At the end of the experimental period basal area showed no significant differences (at the 5% level) between treatments. Contribution by various age groups to basal area and plant density of danthonia also showed no significant differences (5% level) between treatments. When first measured, 5 of the 8 seedling populations were denser in grazed areas than in ungrazed areas and this relationship held for all but one of the ensuing years. The reason for the tremendous decline in basal area in 1951 appears to have been due to the relatively dry summer and fall of 1950-51. High levels of rainfall in 1949 and 1950 probably led to growth that could not be sustained in a dry year. (Carr-Arizona)
W70-07050

SOIL MOISTURE IN RELATION TO VEGETATION DISTRIBUTION IN THE MOUNTAINS OF NORTHERN IDAHO,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 02G.
W70-07051

INFLUENCE OF SUBSURFACE IRRIGATION ON COTTON YIELDS AND WATER USE,
New Mexico State Univ., University Park. Dept. of Agricultural Engineering; and New Mexico State Univ., University Park. Dept. of Agronomy.
Eldon G. Hanson, and B. C. Williams.
American Society of Agricultural Engineers, 1968 Winter Meeting, Chicago, Illinois, December 10-13 1968, Paper presented. 11 p, 4 fig, 2 tab, 10 ref. OWRR Project No A-006 N. Mex.

Descriptors: *Cotton, *Crop production, *Subsurface irrigation, *Irrigation systems, *Irrigation efficiency, Irrigation effects, Irrigation, Surface irrigation, Irrigation design, Water utilization, Water conservation, Consumptive use, Rates of application, Soil water movement, Capillary action, Flow, Plastic pipes.
Identifiers: Suspended particles.

Effect of subsurface irrigation on cotton yield was studied for 3 growing seasons. Cotton plants grown with subsurface irrigation had significantly higher yields than plants grown with surface irrigation. Furthermore, potential water savings obtained by using subsurface irrigation appeared to be in excess of 30%. Perforated half-inch plastic pipe placed 10 to 12 inches deep under each row was the basis of the subsurface system. There was difficulty in obtaining a complete stand of cotton with subsurface irrigation due to the slow rate of capillary flow from the pipe. Flow from pipe to soil was partially obstructed by suspended particles in the water. Pressure had to be increased in order to apply design rates of flow through the system. Rate of water application with the subsurface system ranged from 0.10 to 0.30 inches per day. (Carr-Arizona)
W70-07056

STOMATAL NUMBER AND SIZE AS RELATED TO SOIL MOISTURE IN TREE XEROPHYTES IN ISRAEL,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agricultural Research.
I. Gindel.
Ecology, Vol 50, No 2, p 263-267, Early Spring 1969. 1 fig, 2 tab, 17 ref.

Descriptors: *Stomata, *Soil moisture, *Xerophytes, *Trees, *Plant morphology, Transpiration, Moisture tension, Moisture availability, Epidermis, Leaves, Density, Size, Arid lands, Arid climates, Ecology, Environment, Environmental effects, Irrigation effects, Acclimatization, Climatic zones, Drought, Semiarid climates.
Identifiers: *Israel, *Stomatal density, *Semidesert, *Indigenous species, Introduced species.

Number and size of stomates were measured for 32 tree species and mean leaf area was calculated for 14 of them. Eight of the species were native to Israel and 24 were introduced species, mostly from Australia. Half of the trees of each species were irrigated and half were not. Mean leaf area was larger for 5 irrigated and 8 nonirrigated species, but difference in leaf area was not significant for 11 of them. Stomatal density was significantly higher (at the 1% level) in nonirrigated than in irrigated trees. Stomata appeared on both the upper and lower leaf epidermis in the majority of successfully acclimatized species and some indigenous ones. Especially when compared with trees having stomata only on the lower epidermis, species with stomata on both sides of the blade were noted for their xerophytic properties. Such trees often grew without irrigation in the Israeli semidesert and survived drought periods. (Carr-Arizona)
W70-07057

2J. Erosion and Sedimentation

BANK STABILIZATION IN SUSQUEHANNA RIVER BASIN,
Corps of Engineers, Baltimore, Md. Basin Planning Branch.
For primary bibliographic entry see Field 04D.
W70-06733

DISTRIBUTION OF MAJOR, MINOR, AND TRACE CONSTITUENTS IN UNCONSOLIDATED SEDIMENTS FROM SOUTHERN LAKE MICHIGAN,
Illinois State Geological Survey, Urbana.
Neil F. Shimp, Harry V. Leland, and W. Arthur White.
Illinois Geological Survey Environmental Geology Note No 32, March 1970. 19 p, 4 fig, 3 tab, 9 ref, append.

Descriptors: *Bottom sediments, *Lake Michigan, *Chemical analysis, Trace elements, Ions, Clays, Clay minerals, Organic matter, Lakes, Limnology, Sedimentation, Water analysis, Sampling, Data collections, Water pollution effects, Environmental effects.
Identifiers: Lake Michigan sediments, Environmental geology.

Preliminary results from a study of the chemical composition of southern Lake Michigan sediments indicate that lead, bromine, zinc, nickel, and chromium accumulate in the upper few centimeters of these lake deposits. Concentrations of these elements appear to be related to the amount of organic carbon in the sediments. In deeper sediments, most trace element concentrations increase as the

nount of less than 2-micron clay increases. The mples were subjected to X-ray fluorescence, eutron activation, optical emisson, atomic absorpon, and wet chemical methods. Major conituents determined were Al, Si, Fe, Ca, Mg, K, a, inorganic carbon, and organic carbon. Ti, Mn, , and S were found in smaller amounts. Trace elents determined were B, Be, Br, Cd, Cr, Cu, La, i, Pb, Sc, V, and Zn. Amounts of less than 2-icron clay, clay mineral composition, acidity, and xidation-reduction potential also were deter-ined. (Knapp-USGS)
/70-06748

RODED SOILS OF THE LOWER SWANSEA ALLEY,
niversity Coll. of Swansea (Wales). Dept. of eography.
. M. Bridges.
ournal of Soil Science, Vol 20, No 2, p 236-245, eptember 1969. 10 p, 1 fig, 2 plate, 3 tab, 13 ref.

escriptors: *Soil erosion, *Vegetation effects, Sediment yield, Geomorphology, Topography, Gully erosion, Sheet erosion, Runoff, Soil stability, ir pollution effects.
dentifiers: *Swansea (Wales), Unvegetated soil.

he investigation attempts to ascertain rates and mounts of soil erosion from a small unvegetated rea (120 m X 15 m). Measurements from markers mbedded in the soil indicate a removal of 10 mm er annum on 5 deg slopes, 32 mm per annum on 5 deg slopes, and 43 mm per annum on 62 deg lopes. A sediment trap indicated that in a week vhen there was 56.8 mm rain, approximately 60 g/sq m was eroded. Results of the work are used in n explanation of the eroded soils of a much larger rea, known as the Lower Swansea Valley. (Knapp-JSGS)
W70-06772

BIOTIC REGULATION OF PARTICULATE AND SOLUTION LOSSES FROM A FOREST ECOSYSTEM,
Yale Univ., New Haven, Conn. School of Forestry; and Dartmouth Coll., Hanover, N.H. Dept. of Biological Science.
F. H. Bormann, G. E. Likens, and J. S. Eaton.
Bio Science, Vol 19, No 7, p 600-610, 1969. 11 p, 9 fig, 8 tab, 30 ref. NSF Grants GB1144, GB4169, GB6742, and GB6757.

Descriptors: *Erosion, *Leaching, *Small watershed, *New Hampshire, Ecology, Vegetation effects, Nutrients, Cycling nutrients, Sediment transport, Provenance, Water pollution sources, Hydrologic cycle.
Identifiers: Experimental watersheds.

Major losses of nutrients from terrestrial ecosystems result from two processes: Particulate matter removal accomplished by erosion and transportation in surface drainage water, and solution removal accomplished by dissolution and transportation of solutes by surface and subsurface drainage water. Particulate matter losses from the Hubbard Brook (NH), watershed-ecosystems show seasonal variations, with the bulk of the material being exported during the spring runoff period. However, a single autumnal storm of unusual intensity accounted for 54% of the total particulate matter output during a 2-year period. Total particulate matter losses amounted to 2.5 metric tons/sq km/year. This value is appreciably less than values reported for other similar regions. Total output of dissolved substances was 14 metric tons/sq/km/yr. This is about 25% of the dissolved load predicted for such areas by Langbein and Dawdy (Leopold et al., 1964). The relatively small losses of dissolved substances and particulate matter indicate that the Hubbard Brook ecosystem is very stable. This conclusion is also supported by the biotic structure of the ecosystem. Secondary ecological successions following severe disturbance of forest ecosystems result in significant 'conservation' of nutrients lost from the ecosystem. This effect is achieved by a complex interaction of biomass accumulation, alteration of the hydrologic cycle, reduction of erodibility of the system, and changes in concentration of dissolved substances in drainage waters. (Knapp-USGS)
W70-06778

SOME CHEMICAL CHARACTERISTICS OF AEOLIAN DEPOSITS OF SNOW-SOIL ON PRAIRIE WETLANDS,
Fish and Wildlife Service, Jamestown, N. Dak.
V. A. Adomaitis, H. A. Kantrud, and J. A. Shoesmith.
North Dakota Academy of Science, Vol 21, p 65-69, 1967. 5 p, 4 tab, 3 ref.

Descriptors: *Sedimentation, *Wetlands, *Snow, *Dusts, *Aeolian soils, Dust storms, Blizzards, Silts, Winds, Prairie soils, Soil chemistry, Nutrients, Trace elements.
Identifiers: Prairie potholes.

Broad ecological studies were made to describe the prairie wetlands of North Dakota. A close natural relationship exists between wetland ecology and geochemistry. The type of matter transported during winter storms in the prairie region, and its effect on marshes or other areas where snow is trapped was studied. The aeolian mixture of snow and soil from surrounding fields without vegetation yielded nearly twice as much deposit into the prairie potholes as snow from fields with vegetation. Total alkalinity was 1.7 times as high, total hardness was 1.8, calcium hardness 1.6, magnesium hardness 3.0, and phosphates 1.6, sulfates 1.2 and silica 1.9 times as high. The comparison of nitrate nitrogen levels for clean and dirty snow shows dirty snow to be 2.8 times as high. These ratios imply that fair amounts of top soil travel with the snow during high winter winds. Prevention of wind erosion in winter on the northern prairie also extends the topographical life of waterfowl breeding habitats. (Knapp-USGS)
W70-06801

PRELIMINARY STRATIGRAPHY OF UNCONSOLIDATED SEDIMENTS FROM THE SOUTHWESTERN PART OF LAKE MICHIGAN,
Illinois State Geological Survey, Urbana; and Illinois Univ., Urbana.
J. A. Lineback, W. A. White, N. J. Ayer, Charles Collinson, and H. V. Leland.
Illinois State Geological Survey, Environmental Geology Notes No 30, Feb 1970. 20 p, 6 fig, 2 plates, 11 ref.

Descriptors: *Sediments, *Lake Michigan, Stratigraphy, Sampling, Cores, Clay minerals, Pollutant identification.
Identifiers: Shipek grab sampler, Radiocarbon dating, Clay mineralogy, Unconsolidated sediments, Sedimentary pollution.

Lacustrine sediments were sampled at 4-mile intervals along a line extending from 12 to 32 miles due east from Waukegan, Illinois. The sediment sequence includes a thin floor of sandy silty clay, dark gray and brownish silty clays with black clay interlayers, orange-brown clay, and, finally, pink clay overlying glacial outwash and till. Radiocarbon dating of black interlayers indicated their age at approximately 6920 years. Grain size decreases with depth. Water content of core samples ranges from 100 to more than 200% of dry weight. The cores include illite, chlorite, kaolinite, and expandable clay minerals. The content of the latter decreases with the depth of the sediment in agreement with their degradation to kaolinite. (Wilde-Wisconsin)
W70-06974

CHAPTER IV: SEDIMENT SOURCES AND SEDIMENT YIELDS, PROPOSED MANUAL ON SEDIMENTATION ENGINEERING.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY6, Paper 7337, p 1283-1329, June 1970. 47 p, 26 fig, 10 tab, 93 ref.

Descriptors: *Sediment yield, *Provenence, Sediment load, Stream erosion, Erosion, Highways, Channel erosion, Gully erosion, Sheet erosion, Soil erosion, Urbanization, Strip mines.
Identifiers: Sediment sources.

Methods and procedures are analyzed for determining erosion rates from water-borne sediments, along with sediment yield or deposition rates at locations downstream from the erosion source. Emphasis is placed on the erosion types and processes which cause the most engineering problems, either by virtue of the large sediment quantities involved or by the locally severe damages incurred. Accelerated erosion and deposition rates from man's activities are of special concern; these derive from sheet erosion processes on tilled lands and from such specialized activities as strip mining, urban development, construction of highways and utilities, and sheet erosion on any portion of the land surface that is denuded or inadequately protected. Erosion and deposition rates caused by channelization or runoff waters in upland gullies and downstream drainageways are also considered. Present bases for estimating these rates, on both a storm and an average annual basis, are given. (Knapp-USGS)
W70-06979

EFFECT OF CONCENTRATION GRADIENTS ON THE PERFORMANCE OF A NUCLEAR SEDIMENT CONCENTRATION GAGE,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
For primary bibliographic entry see Field 07B.
W70-07001

RIVERBED DEGRADATION PREDICTION,
Mississippi State Univ., State College.
Zelton L. Hales, Adnan Shindala, and Keith H. Denson.
Water Resources Research, Vol 6, No 2, p 549-556, April 1970. 8 p, 7 fig, 15 ref.

Descriptors: *Scour, *Degradation (Stream), *Stream erosion, *Reservoir operation, Erosion, Bank erosion, Discharge (Water), Dams, Weirs, Sediment load, Particle size, Alluvial channels, Equations.
Identifiers: Riverbed degradation.

A mathematical-graphical procedure for predicting the longitudinal extent of degradation with time downstream from large capacity reservoirs is presented. For such a prediction it is necessary to have an indication of the outflow release rates of the structure, original distribution curves of the bed materials, and channel cross sections. The evaluation of bed slope and the energy slope appears to be a critical factor in the computations. (Knapp-USGS)
W70-07002

STATISTICAL MODEL OF TURBULENCE IN SEDIMENT-LADEN STREAMS,
Kansas State Univ., Manhattan; and Geological Survey, Washington, D.C.
W. J. Conover, and N. C. Matalas.
ASCE Proceedings, Journal of the Engineering Mechanics Division, Vol 95, No EM5, Paper 6814, p 1063-1081, October 1969. 19 p, 1 tab, 9 ref, append.

Descriptors: *Turbulent flow, *Sediment transport, *Probability, *Statistical models, Stochastic processes, Mathematical models, Hydraulics, Sedimentation.
Identifiers: Random walk models.

Turbulent flow in a sediment-laden stream is described by a random walk model which simulates the behavior of sediment particles, fluctuating in depth near the surface of the stream down to the streambed. The basic aspect of this model is the probability laws which govern the transfer of mass for both water and sediment from one level to another throughout the total depth. The downstream velocity at each level is introduced to convert mass to momentum. Three sources of momentum loss are taken into account. The downstream velocities at the various levels, which are unknown, are determined from a set of equations based on the assumption that the expected momentum at a given level equals the sum of the expected momentum contributed from all levels and by gravity. The solution of these equations in the limit where the distance between levels goes to zero leads to the vertical velocity distribution of the sediment-water mixture which is dependent upon four parameters. (Knapp-USGS)
W70-07022

STOCHASTIC HYDRODYNAMICS OF SEDIMENT TRANSPORT,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
Chao-Lin Chiu, and Kuang-Chian Chen.
ASCE Proceedings, Journal of the Engineering Mechanics Division, Vol 95, No EM5, Paper 6858, p 1215-1230, October 1969. 16 p, 22 fig, 4 ref, append.

Descriptors: *Sediment transport, *Mathematical models, *Statistical models, *Stochastic processes, Hydrodynamics, Hydraulics, Model studies, Bed load, Suspended load, Turbulent flow, Monte Carlo method.
Identifiers: Random walk processes.

A stochastic model has been used in a study of sediment transport by the Monte Carlo simulation method. Results include the three-dimensional unsteady sediment distribution that cannot be obtained by conventional techniques, as well as the steady uniform sediment distribution. The diffusion coefficient of sediment is also studied by the simulation method used. Such a method should find its application in a study of the initial, transient, or unsteady mixing pattern of solid wastes released from a point source in a flow field. (Knapp-USGS)
W70-07023

RESEARCH NEEDS REGARDING SEDIMENT AND URBANIZATION,
Geological Survey, Fort Collins, Colo. Water Resources Div.
Harold P. Guy.
Journal of the Hydraulics Division, ASCE Proceedings, Vol 93, No HY6, p 247-254, November 1967. 16 ref. Paper 5596.

Descriptors: *Sediment yield, *Urbanization, *Erosion, Sediment transport, Bed load, Suspended load, Research and development, Water pollution sources, Silts.
Identifiers: Urban hydrology.

Sediment derived from construction in areas of urban growth has profound impact on downstream channels and water resources. Such sediment pollution is usually much more dynamic and intense than sediment derived from rural areas. Research needs concerning urban-derived sediment are similar to those already underway in rural areas; however, new emphasis must be given to exposed subsoils, to problems in existing stream channels, to pollution of existing and future water resources, and to more effective planning and phasing of construction. Some of the needed soils and stream channel research can be accomplished in laboratories, but much needs to be done on small areas at the construction sites. Although many urban research methods can be adapted from related rural programs, consideration must be given to the fact that the extent and location of the exposed subsoils in the drainage basin will change rapidly and that extremely high and variable sediment loads will be imposed upon the stream channels. Better planning and legal backing will make research findings more useful. (Knapp-USGS)
W70-07093

2K. Chemical Processes

SCAVENGING STUDY OF SNOW AND ICE CRYSTALS,
Illinois Inst. of Tech., Chicago.
For primary bibliographic entry see Field 02B.
W70-06744

GOLD CONTENT OF WATER, PLANTS, AND ANIMALS,
Geological Survey, Washington, D.C.
Robert S. Jones.
Report free on application to U S Geological Survey, Wash, D.C. 20242. Geological Survey Circular 625, 1970. 15 p, 3 tab, 75 ref.

Descriptors: *Water chemistry, *Trace elements, *Gold, *Sea water, *Fresh water, Plants, Animals, Surveys, Water analysis, Analytical techniques, Neutron activation analysis, Geochemistry, Solutes, Exploration.
Identifiers: Geochemical prospecting.

Sea water contains from 0.001 to 44 ppb (parts per billion) gold. The amounts of gold in fresh surface waters and groundwaters are also within this range. The average amount of gold in sea water as calculated from neutron activation analyses is 0.05 ppb. The maximum amount of gold detected in plant ash by neutron activation methods is 36 ppm (parts per million) and the average is about 7 ppm. This average, if correct, greatly exceeds the average concentration of gold in the earth's crust. The gold content of dry matter in animals as determined by neutron activation methods ranges from 0.0012 to 430 ppb. On the basis of scanty analyses, terrestrial plants and animals appear to contain more gold than marine plants and animals. (Knapp-USGS)
W70-06761

A STEADY-STATE METHOD FOR DETERMINING DIFFUSION COEFFICIENTS IN SOIL,
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 02G.
W70-06769

TRACE-ELEMENT CONTAMINATION OF PARKLANDS IN URBAN AREAS,
Edinburgh Univ. (Scotland). School of Agriculture.
For primary bibliographic entry see Field 05A.
W70-06770

EFFECTS OF ADSORBED CATIONS ON PHYSICAL PROPERTIES OF TROPICAL RED EARTHS AND TROPICAL BLACK EARTHS: I. PLASTIC LIMIT, PERCENTAGE STABLE AGGREGATES, AND HYDRAULIC CONDUCTIVITY,
Hawaii Agricultural Experiment Station, Honolulu.
For primary bibliographic entry see Field 02G.
W70-06771

QUANTITY AND QUALITY OF LOW FLOW IN THE HONDO CREEK BASIN, TEXAS, MARCH 27-28, 1968,
Geological Survey, San Antonio, Tex.
For primary bibliographic entry see Field 02E.
W70-06774

RATE OF CHEMICAL WEATHERING OF SILICATE MINERALS IN NEW HAMPSHIRE,
Dartmouth Coll., Hanover, N. H.; Yale Univ., New Haven, Conn.; and Forest Service (USDA), Durham, N. H. Northeastern Forest Experiment Station.
Noye M. Johnson, Gene E. Likens, F. H. Bormann, and Robert S. Pierce.
Geochimica et Cosmochimica Acta, Vol 32, p 531-545, 1968. 15 p, 1 fig, 7 tab, 20 ref. NSF Grants GB 1144 and GB 4169.

Descriptors: *Leaching, *Silicates, *Weathering, *Water chemistry, *New Hampshire, Calcium, Sodium, Magnesium, Potassium, Small watersheds, Clay minerals, Mineralogy, Soil chemistry, Soil water.
Identifiers: Soil weathering, Weathering rates.

The losses of dissolved Ca, Na, Mg and K were determined for six small watersheds in New Hampshire during the period 1963-1967. From the rate at which Ca and Na are lost, the steady-state chemical weathering rate is calculated at 800 kg of bedrock-till per hectare per year. Under podzol weathering conditions, a major part of the K and Mg released by the breakdown of primary minerals is apparently retained in pedogenic clays. (Knapp-USGS)
W70-06795

GENESIS OF SOME GROUNDWATERS FROM IGNEOUS ROCKS,
Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.
Robert M. Garrels.
In: Researches in Geochemistry, Volume 2: New York, John Wiley and Sons, Inc, p 405-420, 1967. 16p, 8 fig, 15 ref. NSF Grant (GP-4140).

Descriptors: *Water chemistry, *Leaching, *Igneous rocks, *Groundwater, *Carbon dioxide, Mineralogy, Solubility, Silica, Calcium, Magnesium, Bicarbonates, Equilibrium, Geochemistry, Aqueous solutions.
Identifiers: Groundwater chemistry.

Interpretations that can be made from chemical analyses of actual waters are discussed. Groundwaters from feldspathic igneous rocks are a related group of waters used for illustration. Dilute groundwaters in igneous rocks, as sampled, seem to correspond in composition with the probable results of putting rock samples into water rich in carbon dioxide, closing the system, and then taking solution samples for analyses after various time intervals, assuming that the system is well behaved and that the various solid phases appear promptly after saturation. It should be possible to consider a given natural water analysis as representing a particular stage in an evolutionary sequence--a stage determined by the carbon dioxide content of the original water, the reactivity and surface area of the primary rock minerals, and the residence time of the water. (Knapp-USGS)
W70-06799

Eh AND pH OF OILFIELD WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
A. Gene, Collins.
Producers Monthly, Vol 28, No 9, p 11-12, September 1964. 2 p, 1 fig, 18 ref.

Descriptors: *Water analysis, *Hydrogen ion concentration, *Oxidation-reduction potential, Water chemistry, Analytical techniques, Instrumentation, On-site tests.
Identifiers: Oilfield waters.

Accurate measurements of the Eh (oxidation-reduction potential) and pH (hydrogen ion concentration) of oilfield waters are needed to interpret their complex physicochemical systems. An apparatus was designed to aid in determining the Eh and pH of an oilfield water at the wellhead. A method for determining the Eh and pH of an oilfield water is described and possible applications of the resultant data are discussed. (Knapp-USGS)
W70-06804

RAPID DETERMINATION OF CADMIUM AND COPPER IN PLATING WASTES AND RIVER WATER BY ATOMIC ABSORPTION SPECTROSCOPY,
Missouri Univ., Kansas City. Dept. of Chemistry.
For primary bibliographic entry see Field 05A.
W70-06806

CHEMICAL CHARACTERISTICS OF LAKE ONTARIO,
Bureau of Commercial Fisheries, Ann Arbor, Mich. Biological Lab.
Herbert E. Allen.
Great Lakes Fishery Commission Technical Report No 14, p 1-18, 1969. 1 fig, 5 tab, 14 ref.

Descriptors: *Sampling, *Lake Ontario, *Chemical properties, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Conductivity, Potassium, Sodium, Calcium, Silica, Nansen bottles.
Identifiers: Open water, Chemical variations.

Samples of open water were collected at 106 stations in Lake Ontario with the intention of establishing east-west and surface-subsurface variations in water quality. Determinations of pH values, alkalinity, specific conductance, and dissolved oxygen were performed on the research boat using samples collected with Nansen bottles. Determination of calcium, potassium, sodium, and silica was made in the laboratory. With the exception of dissolved oxygen, Lake Ontario was found to be chemically similar to Lake Erie, which supplies Lake Ontario with 85% of its water. The average concentration of dissolved oxygen in surface water was astonishingly high, varying from 8.85 to 9.76 ppm. (Wilde-Wisconsin)
W70-06966

HYDROCARBON DISTRIBUTION OF ALGAE AND BACTERIA, AND MICROBIOLOGICAL ACTIVITY IN SEDIMENTS,
California Univ., Berkeley. Dept. of Chemistry.
Jerry Han, and Melvin Calvin.
Proceedings of the National Academy of Sciences, Vol 64, No 4, p 436-443, 1969. 3 fig, 4 tab, 21 ref.

Descriptors: *Algae, *Microorganisms, *Bacteria, *Cytological studies, Biochemistry, Lipids, Chemistry, Diagenesis, Sediments, Lakes, Photosynthetic bacteria, Precambrian eras, Rocks.
Identifiers: *Hydrocarbon, Procaryotic cells, Eucaryotic cells, Morphological taxonomy, Nonphotosynthetic bacteria, Microfossils, Blue-green algae.

The evolutionary step from the procaryotic cells of bacteria and blue-green algae to the eucaryotic cells of green algae, higher plants, and animals is marked by the appearance in the latter of specific hydrocarbons, particularly lipids. Determination of various hydrocarbon constituents of blue-green algae, nonphotosynthesizing bacteria, green algae, and photosynthesizing bacteria has indicated that chemistry may have more to contribute than any morphological analysis to the taxonomic classification of living organisms. On the other hand, the studies suggest the diagenesis and certain biological transformations of some hydrocarbons in sediments. (Wilde-Wisconsin)
W70-06969

THE CHEMICAL QUALITY OF IOWA'S WATER RESOURCES,
Geological Survey, Iowa City, Iowa. Water Resources Div.
R. W. Coble.
In: Water Resources of Iowa, Symposium Proceedings, Iowa Academy of Science at Univ of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, p 51-67, Jan 1970. 17 p, 6 fig, 2 tab, 2 ref.

Descriptors: *Water quality, *Surface waters, *Groundwater, *Iowa, Aquifers, Solutes, Streamflow, Runoff, Nitrates, Saline water, Geochemistry, Hydrogeology, Hardness (Water).
Identifiers: Water quality maps.

Water of good quality is available from one or more sources throughout most of Iowa. Hardness and iron are nuisances in many places, but can be treated. Nitrate problems exist in some shallow groundwater supplies and in some streams at times of high runoff. Fluoride concentrations in excess of recommended concentrations are known to occur only in part of two aquifers. Iowa's streams usually contain water with less than 500 mg/l of dissolved solids. When the dissolved-solids content exceeds this amount, it is most generally the result of a higher bicarbonate content which occurs during times of low discharge in the winter months. Alluvial aquifers occupying the valleys of the major streams generally yield water of good quality. A large part of Iowa is underlain by one or more bedrock aquifers that contain good or fair quality water; although poor quality water does occur in all aquifers. The better waters from the bedrock aquifers generally are found in the northeastern one-half of Iowa and in smaller areas in the western and northwestern parts of the state. (See also W70-06981). (Knapp-USGS)
W70-06985

DIFFUSION COEFFICIENT OF SODIUM NITRATE IN AQUEOUS SOLUTION AT 25 DEG C AS A FUNCTION OF CONCENTRATION FROM 0.1 to 1.0M,
Virginia Polytechnic Inst., Blacksburg. Dept. of Chemical Engineering.
H. S. Yeh, and G. B. Wills.
Journal of Chemical and Engineering Data, Vol 15, No 1, p 187-189, January 1970. 3 p, 2 fig, 3 tab, 8 ref. OWRR Project No A-002-VA.

Descriptors: *Diffusion, *Mass transfer, Electrolytes, Laboratory tests, Membrane processes, Mixing, Osmosis.
Identifiers: Diffusion coefficient.

The integral diffusion coefficient of sodium nitrate in aqueous system was determined by the diaphragm cell method in the concentration range from 0.1 to 1.0M at 25 deg C. A stepwise regression method was employed to convert the integral data to differential diffusion coefficient data. (Knapp-USGS)
W70-06994

A SYSTEM FOR THE ANALYSIS OF DISSOLVED OXYGEN, NITROGEN AND ARGON IN NATURAL WATERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
W. Gary Williams.
Report available from Clearinghouse Springfield, Va. as AD-673 426, for $3.00 or $0.65 in microfiche. M.S. Science Thesis, Massachusetts Institute of Technology Duplicated Report, June 1968. 60 p, 14 fig, 4 tab, 20 ref. ONR Contract No 1841 (74).

Descriptors: *Water analysis, *Dissolved oxygen, *Nitrogen, *Argon, *Sea water, Instrumentation, Chromatography, Gases, Calibrations, Chemical analysis, Electrolysis.
Identifiers: Dissolved gas analysis.

A complete system was developed for the shipboard analysis of dissolved oxygen, argon and nitrogen. The system includes a sampler, chromatographic analysis for oxygen, argon and nitrogen, and three modes of calibration. The system was tested in the laboratory and at sea. Estimations of the composition of argon, oxygen and nitrogen in dry air and in air-saturated water are reported. Sea trials indicated that thermistor detectors should be used in the chromatograph instead of hot-filament detectors. (Knapp-USGS)
W70-07030

NUTRIENT CYCLING,
Yale Univ., New Haven, Conn. School of Forestry; and Dartmouth Coll., Hanover, N.H. Dept. of Biological Sciences.
F. H. Bormann, and G. E. Likens.
Science, Vol 155, No 3761, p 424-429, January 27, 1967. 3 fig, 1 tab, 21 ref. NSF Grants GB 1144 and GB 4169.

Descriptors: *Nutrients, *Cycling nutrients, *Small watersheds, Ecology, Energy budget, Food chains, Hydrologic cycle, Research and development, Reviews.
Identifiers: Experimental watersheds.

The small-watershed approach to problems of nutrient cycling has several advantages. The small watershed is a natural unit of suitable size for intensive study of nutrient cycling at the ecosystem level. It provides a means of reducing to a minimum, or virtually eliminating, the effect of the difficult-to-measure variables of geologic input and nutrient losses in deep seepage. Control of these variables makes possible accurate measurement of nutrient input and output (erosion) and therefore establishes the relationship of the smaller ecosystem to the larger biospheric cycles. The small-watershed approach provides a method whereby such important parameters as nutrient release from minerals (weathering) and annual nutrient budgets may be calculated. It provides a means of studying the interrelationships between the biota and the hydrologic cycle, various nutrient cycles, and energy flow in a single system. Finally, with the small-watershed system we can test the effect of various land-management practices or environmental pollutants on nutrient cycling in natural systems. (Knapp-USGS)
W70-07094

2L. Estuaries

SABINE RIVER AUTHORITY OF TEXAS, WATER QUALITY STUDY,
Forrest and Cotton, Inc., Dallas, Tex.
For primary bibliographic entry see Field 05A.
W70-06798

VARIATION OF THE LONGITUDINAL DISPERSION COEFFICIENT IN THE DELAWARE RIVER ESTUARY AS A FUNCTION OF FRESHWATER INFLOW,
Geological Survey, Philadelphia, Pa.
Richard W. Paulson.
Water Resources Research, Vol 6, No 2, p 516-526, April 1970. 11 p, 5 fig, 3 tab, 6 ref.

Descriptors: *Dispersion, *Estuaries, *Saline water intrusion, *Delaware River, *Mixing, Saline water, Saline water-freshwater interfaces, Mathematical models, Water quality, Monitoring.
Identifiers: Delaware estuary.

Three solutions of the one-dimensional steady state diffusion equation for a conservative substance have been derived for an estuary whose cross-sectional area increases linearly in the seaward direction. One solution results from the assumption that freshwater enters the estuary only at the upstream end. The two other solutions result from the assumption that freshwater inflow increases as a function of distance along the estuary. The latter two solutions are separated by different upstream boundary conditions. The three solutions have been tested with U. S. Geological Survey water quality monitor data from a reach of the Delaware estuary. The tests indicate that the longitudinal dispersion coefficient, which is assumed to be spatially constant at any particular time, increases with freshwater inflow from about 140 to 200 sq m/sec as the freshwater inflow at Trenton, New Jersey, increases from 2000 to 6000 cfs (60 to 180 cu m/sec). (Knapp-USGS)
W70-07000

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS,
Nebraska Univ., Lincoln.
William A. Scheller, and Carl E. Georgi.
Available from the Clearinghouse as PB-191 871, $3.00 in paper copy, $0.65 in microfiche. Nebraska University Water Resources Center Technical Completion Report, September 1, 1969. 24 p, 6 tab, 12 ref. OWRR Project No A-007-NEB.

Descriptors: *Desalination processes, *Electrodialysis, *Costs, *Nebraska, Brackish water, Brines, Saline water, Economics, Water supply, Water wells, Water resources development.
Identifiers: Desalination costs.

Samples obtained from four brackish wells in eastern Nebraska and two NaCl solutions were used in conjunction with a laboratory electrodialysis unit to establish the process parameters necessary for estimating the cost of desalination. Investment and maintenance estimates for a 1000 GPD electrodialysis unit were also obtained. The cost of fresh water (500 ppm total solids) produced from brackish water (980 to 6460 ppm of total solids) was $2.30 to $7.78 per 1000 gallons including a 5% cost for investment capital. At a typical rural consumption of 60 gallons per person per day, the above fresh water costs are equivalent to 14 cents to 48 cents per person per day. These figures assume electric power is available at 3.3 cents/kwh, a typical rural Nebraska rate. If the electrodialysis unit were supplied with brackish water from an existing pressurized system and with reduced maintenance costs, the desalinated water costs would be reduced by 57 cents to $1.59 per 1000 gallons, depending on the specific case. (Knapp-USGS)
W70-06755

3B. Water Yield Improvement

WATER USE, ADAPTABILITY, AND CHEMICAL COMPOSITION OF GRASSES SEEDED AT HIGH ELEVATIONS,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
Ronald K. Tew.
Journal of Range Management, Vol 22, No 4, p 280-283, July 1969. 4 p, 2 tab, 7 ref.

Descriptors: *Evapotranspiration, *Water yield improvement, *Consumptive use, *Grasses, *Utah, Bromegrass, Orchardgrass, Wheatgrasses, Oats, Forage grasses, Range management, Forest management, Land management, Evapotranspiration control, Water conservation, Water loss.

Soil moisture depletion varied directly with extent of top and root growth of five grass species seeded on four areas between 6,500 and 8,500 ft in northern Utah. Smooth bromegrass and intermediate wheatgrass had greater root and top growth and used the most moisture at the lower elevation site where temperature were highest, but timothy and orchardgrass grew best at higher elevations; timothy contained low levels of nitrogen, phosphorus, and potassium on all sites, whereas tall oatgrass and orchardgrass contained high levels. (Knapp-USGS)
W70-06775

WATER OUT OF THE DESERT,
Washington State Univ., Pullman. Dept. of History.
Christopher M. Wallace.
Southwestern Studies, Vol 6, No 2, University of Texas at El Paso, Monograph No 22, 1969. 48 p. 7 fig, 9 photo, 34 ref.

Descriptors: *Texas, *Municipal water, *Water supply, *Water shortage, *Water sources, Groundwater, Aquifers, Hydrogeology, Groundwater mining, Overdraft, Arid lands, Surface waters, Rio Grande, Water table, Drawdown, Saline water intrusion, Artesian wells, Subsurface waters, Groundwater basins, Wells, Hydraulic gradient, Rainfall, Evapotranspiration, Caliche, Water treatment, Drilling, Dissolved solids, Water hardness, Sewage treatment, History, Mexican Water Treaty.
Identifiers: *El Paso (Texas), *Hueco Bolson, Rio Grande Valley, Elephant Butte Reclamation Project, Santa Fe formation.

Growth and development of the El Paso, Texas, municipal water system are outlined in the monograph. Hydrogeology of the area is discussed with emphasis on such problems as groundwater depletion and saline water intrusion. Also included is the past, present and potential importance of the various local water-producing areas. Technological methods of obtaining water in the El Paso region and the influence of city policies on the water supply problem in El Paso are described. (Carr-Arizona)
W70-06824

WATER RESOURCES OF IOWA.
Iowa State Geological Survey, Iowa City.
For primary bibliographic entry see Field 06B.
W70-06981

GLACIERS OF THE CENTRAL CHILEAN ANDES AND THEIR IMPORTANCE TO THE WATER RESOURCES,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02C.
W70-06989

INCREASES IN WATER YIELD FOLLOWING CLEAR-CUT LOGGING IN THE PACIFIC NORTHWEST,
US Forest Service (USDA), Corvallis, Oreg. Pacific Northwest Forest and Range Experimental Station.
Jack Rothacher.
Water Resources Research, Vol 6, No 2, p 653-658, April 1970. 6 p, 4 fig, 13 ref.

Descriptors: *Water yield improvement, *Clear-cutting, *Small watersheds, Forest management, Land clearing, Watershed management, Runoff, Water yield.
Identifiers: Cascade Range (Oregon).

Increases in water yield following timber harvest roughly conform to the proportion of the area cleared. In high precipitation areas of the Oregon Cascades, clear-cut logging can increase annual water yield 18 inches. Approximately 80% of the increase occurs during the October to March season. (Knapp-USGS)
W70-07007

PROTECTIVE SPRAY COATINGS FOR WATER HARVESTING CATCHMENTS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Gary W. Frasier, and Lloyd E. Myers.
American Society of Agricultural Engineers, 1968 Summer Meeting, Logan, Utah, June 18-21 1968, Paper No. 68-234. 14 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Water harvesting, *Paving, *Protective coatings, *Sealants, *Durability, Coatings, Paints, Linings, Spraying, Inhibitors, Waterproofing, Rubber, Soil asphalt, Asphalt, Construction materials, Colorimetry, Runoff, Rates of application, Costs, Failures, Deterioration, Emulsions.
Identifiers: *Catchments, *Discoloration, Photooxidation.

Low-cost protective coatings for improving durability of asphalt-paved water harvesting catchments were evaluated in laboratory and field studies. Degree of water discoloration was used as the indicator of pavement deterioration. Colorimetric procedures were used to measure discoloration of runoff water from two standard asphalt seal coats, two protective coatings, and a soil-stabilizing asphalt. Using RSK asphalt emulsion as standard, reduction in discoloration in the first year after application was 95% for rubberized aluminum paint, 70% for aluminized asphalt paint, and 54% for asphalt clay emulsion. MC-3 Venezuelan asphalt (derived from Venezualan crude oil) discolored water 50 to 75% less than RSK asphalt (derived from California crude oil). On an operational water catchment the area treated with aluminum asphalt paint was in good condition after two and one-half years but the untreated asphalt had failed. The coatings are still experimental, but they are easy to apply and cost less than five cents per square yard. (Carr-Arizona)
W70-07058

3D. Conservation in Domestic and Municipal Use

URBAN AND INDUSTRIAL WATER SUPPLY: PROSPECTS AND POSSIBILITIES,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 06D.
W70-06935

THE EMBATTLED COLOSSUS: NEW YORK CITY WATER SUPPLY SYSTEM, ITS PAST, PRESENT, AND FUTURE,
New York City Environmental Protection Administration.
Robert D. Clark.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968, p 25-33.

Descriptors: *Water supply, *New York, *Conservation, *Measurement, *Desalination, *Delaware River, Legal aspects.
Identifiers: *Hudson-Adirondack project, Catskill system, Croton system.

An historical view of New York's water supply system is given with emphasis on attempted means of augmenting the supply. The Catskill System first envisioned in 1904 and finally completed in 1927 had no sooner been finished than a new source was needed. Diversion of the Delaware followed but the drought of 1949-1950 indicated that the coming decades would require an even larger supply. Further diversion of the Delaware with the Cannonsville project was initially predicted to provide a supply sufficient until 2010. However, the northeast drought (1961-1967) had a horrendous effect on the New York Water Supply System. Survival of the drought was through conservation and management efforts which reduced average consumption by 25 per cent. New attempts to develop a Hudson-Adirondack project realized that a state or regional Commission was needed. Renovation of municipal departments to manage water as a total resource from mountain stream to sewer effluent led to the Department of Water Resources in the Environmental Protection Administration. Completion of the Cannonsville Reservoir and building of the Richmond tunnel for Staten Island are reviewed as is construction of a third tunnel to augment present city facilities in the Croton System. A Federal study of desalination suggests that this may play a role in the future in solving local water supply problems. Finally, the need for universal metering and problems involved in this task are reviewed. (Preckwinkle-Chicago)
W70-06939

WATER FOR CITIES,
Corps of Engineers, Washington, D.C.
For primary bibliographic entry see Field 06B.

W70-06940

METROPOLITAN AREA WATER RESOURCE PROBLEMS,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
For primary bibliographic entry see Field 06B.
W70-06941

CONTEMPORARY DEVELOPMENTS IN WATER LAW.
For primary bibliographic entry see Field 06E.
W70-07095

A MODEL WATER USE ACT FOR A RIPARIAN STATE--THE FLORIDA EXPERIENCE,
For primary bibliographic entry see Field 06E.
W70-07096

PUBLIC RIGHTS IN PUBLIC RESOURCES: THE CITIZEN'S ROLE IN CONSERVATION AND DEVELOPMENT,
For primary bibliographic entry see Field 06E.
W70-07105

3E. Conservation in Industry

CONTEMPORARY DEVELOPMENTS IN WATER LAW.
For primary bibliographic entry see Field 06E.
W70-07095

A MODEL WATER USE ACT FOR A RIPARIAN STATE--THE FLORIDA EXPERIENCE,
For primary bibliographic entry see Field 06E.
W70-07096

3F. Conservation in Agriculture

AUTOMATION OF IRRIGATION SYSTEMS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
Paul E. Fishbach.
Paper presented at 155th Meeting of Missouri Basin Interagency Committee, State Capitol Building, Lincoln, Nebraska, December 10-12, 1968. 13p, 10 fig, 3 ref.

Descriptors: *Irrigation systems, *Automatic control, *Water reuse, Irrigation efficiency, Irrigation practices, Crop response, Water delivery.
Identifiers: Automatic irrigation control.

Two experimental surface irrigation systems operating with a reuse system are described. An automated surface irrigation system with reuse system was installed during 1966 at the University of Nebraska Field Laboratory, Mead, Nebraska, and has been operated three irrigation seasons. An irrigation well with an electrically powered pump rated at 1200 gallons per minute was utilized as the water source. Runoff from 2 fields drains into a common drainage ditch which outlets into a collection pit. An electrically driven reuse pump was installed in the collection pit to pump the runoff water back into the main water supply line. Automatically controlled irrigation valves were used on the risers of the buried pipeline. The second automated surface irrigation system with a reuse system was installed during 1968 at the University of Nebraska Field Laboratory, Mead, Nebraska. This system utilized the same irrigation well, buried pipeline to the head of the field and, air compressor. The corn irrigated with the automated surface irrigation system produced 180 bushels per acre. Water use efficiencies varied from 86 to 94%. The estimated cost of System No. 1 is about $18,000 for 160 acres and on System No. 2 the estimated cost is $10,000 per 160 acres. (Knapp-USGS)
W70-06797

CENTURY ONE, 1869-1969, ONE HUNDRED YEARS OF WATER DEVELOPMENT IN THE SALT RIVER VALLEY,
Stephen C. Shadegg.
Stephen C. Shadegg, Phoenix, Arizona, 1969. 48p

Descriptors: *Arizona, *History, *Reclamation states, *Arid lands, *Irrigation, Arid climates, Economic impact, Agriculture, Hydroelectric power, Water storage, Urbanization, Reservoir storage, Federal Reclamation Act, Drought, Water rights, Dams, Multiple-purpose projects.
Identifiers: *Salt River, *Salt River Valley, *Salt River Project, *Central Arizona, *Salt River Valley Water Users' Association, Irrigated agriculture, Kibbey plan.

The basic history of the Phoenix area is outlined, with particular attention on the growth of irrigated agriculture. The life of the Salt River Project is the major interest of the monograph, which goes into detail of irrigation in the Salt River Valley, passage of the National Reclamation Act of 1902, organization of the Salt River Valley Water Users' Association in 1903 and its growth to the present. Changes in orientation toward urban and industrial water use are mentioned, as is the influence of the project on the economic development of Arizona. (Carr-Arizona)
W70-06807

ARTIFICIAL SELECTION FOR SEEDLING DROUTH TOLERANCE IN BOER LOVEGRASS (ERAGROSTIS CURVULA NEES),
Arizona Univ., Tucson. Dept. of Agronomy; and Agricultural Research Service. Tucson, Ariz. Crops Research Div.
For primary bibliographic entry see Field 02I.
W70-06809

WATER REQUIREMENTS IN STRAINS OF VINE-MESQUITE (PANICUM OBTUSUM H. B. K.),
New Mexico State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 02I.
W70-06812

WATER-USE EFFICIENCY AND ITS ASSOCIATION WITH SEVERAL CHARACTERISTICS OF BLUE PANICGRASS (PANICUM ANTIDOTALE RETZ.) CLONES,
Arizona Univ., Tucson. Dept. of Agronomy; and Agricultural Research Service, Tucson, Ariz. Crops Research Div.
For primary bibliographic entry see Field 02I.
W70-06814

CORN YIELDS, SOIL TEMPERATURE, AND WATER USE WITH FOUR TILLAGE METHODS IN THE WESTERN CORN BELT,
Agricultural Research Service, Brookings, S. Dak. Corn Belt Branch; and South Dakota Agricultural Experiment Station, Brookings.
For primary bibliographic entry see Field 02I.
W70-06817

INTRODUCTION OF HYDROPONICS IN COLORADO; TECHNIQUE AND IMPLICATIONS IN A SEMI-ARID REGION,
Colorado State Univ., Fort Collins. Dept. of Horticulture.
Joe J. Hanan, and W. D. Holley.
Agricultural Meteorology, Vol 7, No 1, p 29-38, January 1970. 5 fig, 27 ref.

Descriptors: *Hydroponics, *Greenhouses, *Water resources, *Arid lands, *Colorado, Semiarid climates, Arid climates, Environment, Agriculture, Horticulture, Plants, Consumptive use, Water utilization, Evapotranspiration, Irrigation, Irrigation programs, Water conservation, Water pollution, Water quality, Waste water (Pollution), Pollution abatement, Saline water.
Identifiers: *Carnations, Solar regimes.

Use of hydroponics in the greenhouse industry has never been widely practiced. Recently, however, plant cultivation in inert substrates has gained widespread acceptance in Colorado. The basic technique in use there for growing carnations is described and illustrated. It is pointed out that, even when grown in soil, a single carnation cut flower probably uses 3.41 of water during its development. Evidence indicates that growth by hydroponics may double the water requirement per flower. Thus, although arid regions offer solar regimes most suited for greenhouse production using inert media, introduction of hydroponics would put increasing pressures on water resources. Also, more frequent water cycling required by this method would produce additional waste water, which would lead to increased pollution problems. The total picture indicates that even though saline water could possibly be utilized in a hydroponic system, no significant returns to arid lands in pollution abatement or water conservation appear likely. (Carr-Arizona)
W70-06818

EFFICIENCY OF WATER USE AND SEEDLING DROUGHT TOLERANCE OF BOER LOVEGRASS, ERAGROSTIS CURVULA NEES,
Arizona Univ., Tucson. Dept. of Agronomy; and Agricultural Research Service, Tucson, Ariz. Crops Research Div.
For primary bibliographic entry see Field 02I.
W70-06819

WATER IMPORT SYSTEMS FOR ARID LAND DEVELOPMENT,
Parsons (Ralph M.) Co., Los Angeles, Calif.
Charles Poll.
Symposium on Increasing Food Production in Arid Lands, Texas Tech College, Lubbock, International Center for Arid and Semi-Arid Land Studies, Publication No. 3, p 43-54, 1969. 3 fig.

Descriptors: *Water transfer, *Interbasin transfer, *Arid lands, *Mexico, *United States, Water conveyance, Canals, Reservoirs, Reservoir storage, Pumped storage, Water delivery, Irrigation, Electric power, Electric power production, Hydroelectric plants, Thermal powerplants, Economic feasibility, Industrial water, Municipal water, Mississippi River.
Identifiers: *Canada, *North America, *American Desert, *NAWAPA (North American Water and Power Alliance), *Mushec (Mexican-United States Hydroelectric Commission), Rocky Mountain Trench, Irrigated agriculture.

The American Desert is one of the few large areas in the world in which conditions are favorable for irrigated agriculture on a massive scale. Among the proposals for importing water into this area are two plans known as NAWAPA (North American Water and Power Alliance) and MUSHEC (Mexico-United States Hydroelectric Commission). NAWAPA would collect and store water from the northwestern portion of the North American continent and distribute it via canals and tunnels to parts of Canada, the United States, and Mexico. The system would handle 158,000,000 acre feet of water per year and would have a total installed power generating capacity of 110,000,000 kilowatts. The MUSHEC system envisions utilizing flood waters from the Mississippi River and from the Isthmus of Tehuantepec region of the Sierra Madre Oriental. Canals, pipes, and tunnels would distribute 129,000,000 acre feet per year to northern Mexico and parts of Kansas, Oklahoma, New Mexico, and Texas. Preliminary studies of NAWAPA indicate that the project is economically feasible. Economic aspects of MUSHEC have not yet been studied. (Carr-Arizona)
W70-06821

UTILIZATION AND MANAGEMENT OF WATER IN THE ARID ZONES OF MEXICO (IN SPANISH),
Instituto Tecnologico y de Estudios Superiores de Monterrey (Mexico). Departmento de Suelos e Irrigacion.

For primary bibliographic entry see Field 02I.
W70-06825

THE INTEGRATED USE OF GROUND AND SURFACE WATER IN IRRIGATION PROJECT PLANNING,
Harvard Univ., Cambridge, Mass. Center for Population Studies.
Peter Rogers, and Douglas V. Smith.
American Journal of Agricultural Economics, Vol. 52, No. 1, p. 13-24, Feb. 1970. 12 p, 5 fig, 5 tab, 13 ref.

Descriptors: *Project planning, *Irrigation design, *Linear programming, Surface-groundwater relationships, Drainage, Water requirements, Water management (Applied).

A linear programming model determines water balances for a project area. Interactions of a surface water-groundwater system within the economic context of irrigation management are emphasized. Tubewell, canal and surface drainage capacities, the project size, and cropping pattern are all selected by the linear program. The program is designed within the constraints on continuity at the river; capacity of the canals, tubewells, and drainage channels; mining of groundwater; crop water requirements; availability of land of different soil types; and permissible crop patterns. An example of irrigation planning by linear programming is included. (Grossman-Rutgers)
W70-06837

RECHARGE OF GROUNDWATER FROM RENOVATED SEWAGE EFFLUENT BY SPRAY IRRIGATION,
Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 04B.
W70-06953

ECONOMICS OF IRRIGATION SYSTEM CONSOLIDATION,
Colorado State Univ., Fort Collins. Dept. of Economics.
Paul C. Huszar, D. W. Seckler, and D. D. Rohdy.
Colorado State University Experiment Station, Technical Bulletin 105, Dec. 1969. 50 p, 25 tab, 11 fig, 7 append, 23 ref.

Descriptors: *Consolidation, *Irrigation ditches, *Economic feasibility, Welfare (Economics), Mathematical studies, Systems analysis.
Identifiers: *Northern Colorado Water Conservancy District No. 3.

Possible economics resulting from complete or partial consolidation of the system of irrigation ditches located in the Northern Colorado Water Conservancy District No. 3 are examined. Three consolidation plans were studies to determine whether or not any of them are economically feasible. Their operations were simulated in order to make comparisons between the alternative schemes. The alternative plans were ranked according to preference with respect to both upper and lower irrigation systems. Preference ordering of the entire system were then derived. To perform the ranking, simultaneous confidence intervals, in terms of future benefits and costs, were used. The maximum welfare of the entire system was used as the basic criterion. (Grossman-Rutgers)
W70-06956

DISSIPATION OF ENDOTHALL AND EFFECTS ON AQUATIC WEEDS AND FISH,
California Univ., Davis. Dept. of Botany.
R. R. Yeo.
Weed Science, Vol 18, No 2, p 282-284, 1970. 4 tab, 5 ref.

Descriptors: *Herbicides, *Aquatic weeds, Fish, Calcium chloride, Farm ponds.
Identifiers: *Endothall, Lethal effects, Plastic growth pools, Elodea canadensis, Duckweed, Nitella, Chara, American elodea, Mosquitofish.

Fourteen farm ponds and water in small plastic growth pools were treated with sodium and potassium salts of endothall applied at rates from 0.3 to 4.0 ppm. The chemical controlled pond weeds with the exception of American elodea, common duckweed, nitella, and chara. Smallmouth bass and sunfish survived the treatment, but some mosquitofish, especially females, were killed in growth pools. The decrease in concentration of endothall averaged 71% during 12 days. Addition of calcium chloride failed to exert significant influence, partially because of the amount of chemical applied was too small to produce an appreciable ecological change of water. (Wilde-Wisconsin)
W70-06971

AGRICULTURAL DEVELOPMENT IN NORTHERN MEXICO, 1940-1960,
Stanford Univ., Calif.
W. Whitney Hicks.
Land Economics, Vol 43, No 4, p 393-402, November 1967. 1 fig, 1 tab, 16 ref.

Descriptors: *Mexico, *Crop production, *Irrigated land, *Cotton, *Wheat, Irrigation programs, Irrigation effects, Irrigation, Land use, Farm prices, Crops, Tomatoes, Strawberries, Melons, Economics, Foreign countries, Government, Federal government, Government supports, Arid lands, Agriculture, Credit.
Identifiers: *Northern Mexico, *Agricultural development, *Irrigated agriculture, Labor productivity, Mechanization.

The rapid increase in crop production in northern Mexico between 1940 and 1960 is analyzed. During this period agricultural production in the area grew at an annual rate of 9%, compared to 5% for the Gulf of Mexico and Pacific South regions and 3% for the Central region. One factor influencing rapidly rising crop production was the high rate of growth of cotton and wheat, which are primarily grown in the North and Pacific North census regions. As of 1960, these two regions produced 99% of the cotton in Mexico, 71% of the wheat, and 65% of the melons, tomatoes, and strawberries. Other factors influencing growth of crop production include favorable prices, higher labor productivity, irrigation development, mechanization, and differences in landholding systems. Irrigated land in northern Mexico grew at a rate of 4.1% yearly between 1940 and 1960 and constituted approximately 75% of the total increase in irrigated land in Mexico. Over half of the irrigation projects in the area were government-constructed. Such data support the thesis that development of the cotton and wheat crop in Mexico has depended to a large degree on decisions of the Mexican government as to whether and where to build irrigation works. (Carr-Arizona)
W70-07052

ENVIRONMENTAL EFFECTS OF IRRIGATION IN THE CENTRAL VALLEY OF ARIZONA,
Arizona Univ., Tucson. Dept. of Agricultural Engineering; and Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 06G.
W70-07053

INFLUENCE OF SUBSURFACE IRRIGATION ON COTTON YIELDS AND WATER USE,
New Mexico State Univ., University Park. Dept. of Agricultural Engineering; and New Mexico State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 02I.
W70-07056

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

SEEPAGE INVESTIGATION OF MEDINA CANAL, BEXAR-MEDINA-ATASCOSA COUNTIES, TEXAS, WATER IMPROVEMENT DISTRICT NO 1 CANAL SYSTEM, AUGUST 15, 1969,
Geological Survey, Austin, Tex.
Larry F. Land.
Geological Survey Open-file report (dupl), April 1970. 5 p, 1 fig, 1 tab, 1 ref.

Descriptors: *Canal seepage, *Evapotranspiration, *Water loss, *Canals, *Texas, Surface-groundwater relationships, Infiltration, Discharge (Water), Streamflow.
Identifiers: Medina Canal (Texas).

Measurements of flow in the Medina Canal, Texas on August 15, 1969, showed a loss of 4 cfs in a 24-mile reach between the gaging station near Riomedina and a measurement site near Pearson. Although the canal bed material is primarily earthen, except for about one-half mile of concretelined channel at the upper end of the study reach, no significant losses were found. Most of the decrease in flow (106 to 102 cfs) is attributed to evaporation and transpiration. (Knapp-USGS)
W70-06745

ESTIMATION MONTHLY STREAMFLOWS WITHIN A REGION,
Corps of Engineers, Sacraments, Calif. Hydrologic Engineering Center.
Leo R. Beard, Augustine J. Fredrich, and Edward F. Hawkins.
Hydrologic Engineering Center Technical Paper No 18, U S Army Corps of Engineers, Sacramento, California, Jan, 1970. 14 p, 3 fig.

Descriptors: *Streamflow forecasting, *Estimating, *Synthetic hydrology, Water resources development, Runoff forecasting, Data processing, Computer programs, Mathematical models, Mathematical studies.
Identifiers: *Peru.

Techniques developed in The Hydrologic Engineering Center of the Corps of Engineers for reconstituting missing portions of monthly streamflow data are being tested by applications in the Pacific coastal area of Peru. To develop the coordinated set of streamflow records, a base period of 50 years was selected, and missing monthly streamflow data were estimated at each of the 60 gaged locations, using regional analysis and correlation with appropriate physical and hydrologic characteristics. From this complete set of streamflow records, concurrent values for each of the 40 remaining ungaged locations will be estimated. Monthly streamflow quantities are produced to enable the Peruvian government to evaluate water resources developments along the western coast, and provide information for comparison of alternative schemes of development. (Knapp-USGS)
W70-06747

ANNUAL PEAK DISCHARGES FROM SMALL DRAINAGE AREAS IN MONTANA THROUGH SEPTEMBER 1969,
Geological Survey, Helena, Mont.
For primary bibliographic entry see Field 02E.
W70-06752

ZIMMERMAN V UNION PAVING CO (OBSTRUCTION OF PIPE CONVEYING SPRING

WATERS).

6 A2d 901-905 (Penn 1939).

Descriptors: *Pennsylvania, *Springs, *Water conveyance, *Excavation, Right-of-way, Water rights, Judicial decisions, Legal aspects, Spring waters, Seepage, Prescriptive rights, Damages, Relative rights, Competing uses, Gravitational water, Alteration of flow, Obstruction to flow, Land tenure, Pipes, Pipelines.

A deed gave plaintiff a right to conduct water through a pipe from a designated spring on land retained by his grantor and a right to use water from an unnamed spring thereon. Plaintiff conveyed water from both springs through pipes to his property for over eight years. Defendant, who had acquired a right to remove soil from the grantor's land, was warned of the likely result if excavation was continued in the vicinity of the unnamed spring. Subsequently, because of continued excavation, the water flow through the plaintiff's pipe from the unnamed spring was halted and plaintiff had to transport the water from the unnamed spring by hand. Plaintiff's action to recover for the interference with his property right in the unnamed spring resulted in a favorable judgment. The Pennsylvania Supreme Court, in reversing for defendant, held that where a deed expressly grants plaintiff a right to conduct water from a designated spring on his grantor's land through a pipe to plaintiff's premises, but merely gives plaintiff the right to get his water from an unnamed spring, such deed inferentially precludes the right to convey water from the unnamed spring by the use of a pipe. Also plaintiff's use of a pipe from the unnamed spring for several years had not created an easement by prescription but merely a license and defendant's acts had not deprived plaintiff of a property right. (Powell-Florida)
W70-06757

FLOOD PLAIN INFORMATION, BOULDER CREEK AND SOUTH BOULDER CREEK: VOLUME II - BOULDER METROPOLITAN REGION, COLORADO.
Corps of Engineers, Omaha, Nebr.

Corps of Engineers Flood Plain Report, August 1969. 34 p, 13 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Colorado, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Boulder (Colo), Standard project flood, Intermediate regional flood.

Flooding of Boulder, Colorado is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06767

FLOOD PLAIN INFORMATION, TUALATIN RIVER AND TRIBUTARIES, WASHINGTON COUNTY, OREGON.
Corps of Engineers, Portland, Oreg.

Corps of Engineers Flood Plain Report, June 1969. 71 p, 9 fig, 72 plate, 23 tab.

Descriptors: *Floods, *Flood damage, *Oregon, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Tualatin River (Oreg), Standard project flood, Intermediate regional flood.

Flooding of the Tualatin River, Washington County, Oregon is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06773

FLOOD PLAIN INFORMATION ON MAIN STEM AND SOUTH BRANCH BIG TIMBER CREEK IN CAMDEN AND GLOUCESTER COUNTIES, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

Corps of Engineers Flood Plain Report, March 1969. 49 p, 4 fig, 16 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Camden County (NJ), Gloucester County (NJ).

Flooding of Big Timber Creek, Camden and Gloucester Counties, New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06777

FLOOD PLAIN INFORMATION, CHRISTINA RIVER, EAST AND WEST BRANCHES, NEWARK, NEW CASTLE COUNTY, DELAWARE.
Corps of Engineers, Philadelphia, Pa.

Corps of Engineers Flood Plain Report, May 1969. 45 p, 9 fig, 14 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Delaware, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Christina River (Del), Standard project flood, Intermediate regional flood.

Flooding of the Christina River, East and West Branches, Newark, Delaware is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06781

FLOOD PLAIN INFORMATION OF UMATILLA RIVER IN MISSION - RIVERSIDE AREA NEAR PENDLETON, OREGON.
Corps of Engineers, Walla Walla, Wash.

Corps of Engineers Flood Plain Report, November 1969. 31 p, 10 fig, 11 plate, 2 tab.

Descriptors: *Floods, *Flood damage, *Oregon, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Mission (Ore), Riverside (Ore), Standard project flood, Intermediate regional flood.

Flooding of the Umatilla River in the Mission - Riverside area, Oregon is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06785

FLOOD PLAIN INFORMATION, SOUTH FORK EEL RIVER, PHILLIPSVILLE TO GARBERVILLE, HUMBOLDT COUNTY, CALIFORNIA.
Corps of Engineers, San Francisco, Calif.

Corps Engineers Flood Plain Report, June 1969. 35 p, 7 fig, 22 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Humboldt County (Calif).

Flooding of the South Fork Eel River, Humboldt County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06786

FLOOD PLAIN INFORMATION, CALLEGUAS CREEK, VENTURA COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.

Corps of Engineers Flood Plain Report, September 1969. 59 p, 34 fig, 45 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Ventura County (Calif), Standard project flood, Intermediate regional flood.

Flooding of Calleguas Creek, Ventura County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06787

MAXIMUM UTILIZATION OF SCARCE DATA IN HYDROLOGIC DESIGN,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 07C.
W70-06788

FLOOD PLAIN INFORMATION, BARTON, MILL, AND STONE CREEKS, BOUNTIFUL,

WEST BOUNTIFUL, AND WOODS CROSS, UTAH.
Corps of Engineers, Sacramento, Calif.

Corps of Engineers Flood Plain Report, December 1969. 35 p, 16 fig, 12 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Utah, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: *Davis County (Utah), Standard project flood, Intermediate regional flood.

Flooding in Bountiful, West Bountiful, and Woods Cross, Utah is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06789

EVALUATING HERBICIDES AGAINST AQUATIC WEEDS,
Agricultural Research Service, Fort Lauderdale, Fla. Crops Research Div.
Robert D. Blackburn.
Weeds, Vol 11, No 1, p 21-24, January 1963. 4 p, 2 fig, 4 tab, 10 ref.

Descriptors: *Herbicides, *Aquatic weeds, *Weed control, *Aquatic weed control, Diquat (2-4-D), Alligatorweed, Toxicity, Surface waters.
Identifiers: Herbicide effectiveness, Acrolein, Silvex.

Techniques were developed for evaluating herbicides on submersed, floating, and emersed aquatic weeds. Among 75 herbicides evaluated on three species of submersed weeds only diquat, paraquat, endothal, and acrylaldehyde (acrolein) gave 85% or better control at 1 ppmw in still-water tests. Only acrolein and endothal were effective on submersed weeds at 1 ppmw in the limited-exposure test. The evaluation of 17 herbicides on three species of floating aquatic weeds indicated that diquat was effective when applied at rates of 1 or 2 lb/A. The tertiary fatty acid amines of 2,4-D were more effective on floating weeds than an ester of 2,4-D. Many of the 78 herbicides evaluated on alligatorweed killed the tops, but only two retarded the sprouting of underwater nodes longer than 6 weeks. Applications of 20 lb/A of silvex in two formulations retarded sprouting of underwater nodes for 8 weeks. (Knapp-USGS)
W70-06805

CENTURY ONE, 1869-1969, ONE HUNDRED YEARS OF WATER DEVELOPMENT IN THE SALT RIVER VALLEY,
For primary bibliographic entry see Field 03F.
W70-06807

WATER IMPORT SYSTEMS FOR ARID LAND DEVELOPMENT,
Parsons (Ralph M.) Co., Los Angeles, Calif.
For primary bibliographic entry see Field 03F.
W70-06821

WATER OUT OF THE DESERT,
Washington State Univ., Pullman. Dept. of History.
For primary bibliographic entry see Field 03B.
W70-06824

SLATTEN V MITCHELL (SUIT TO ENJOIN UPHILL LANDOWNER FROM BUILDING BARRIER TO KEEP DRAINAGE WATER OFF HIS LAND).

124 SW2d 310-320 (Tenn Ct App 1938).

Descriptors: *Tennessee, *Rrepulsion (Legal aspects), *Drainage systems, *Relative rights, Natural flow, Surface water, Ditches, Easements, Prescriptive rights, Land tenure, Drainage, Barriers, Flood protection, Remedies, Dams, Diversion structures, Legal aspects, Sinks, Judicial decisions, Obstruction to flow, Drainage water, Surface runoff, Walls, Ditches.

Plaintiffs sought to enjoin defendants from building a wall along a drainage ditch running through plaintiff's and defendants' properties. Although defendants left a gap in the wall to allow excess water to flow into a sink on defendants' land, plaintiffs claimed that the effect of the wall was to keep the drainage water from flowing onto defendants' uphill property and to cast an abnormally large amount of surface runoff onto plaintiffs' downhill lands. After holding that the common enemy doctrine, whereby a landowner may dispose of surface water as best he can, was not i n force in Tennessee, the court stated that a landowner could protect his property from injury by surface water if the rights of others were respected. The court held that because much of the water was put into the ditch by lateral ditches uphill from defendants' property, defendants had the right to take reasonable steps to keep the runoff from overflowing their land. Plaintiffs were held to have no prescriptive right to have the drainage water diverted onto defendants' property, and the complaint was dismissed. (Caldwell-Florida)
W70-06870

BEAUTON V CONNECTICUT LIGHT AND POWER CO (FLOODING, AN ACT OF GOD).
3 A 2d 315-319 (Conn 1938).

Descriptors: *Connecticut, *Dams, *Floods, *Impounded waters, Water rights, Flood damage, Judicial decisions, Legal aspects, Historic flood, Flood gates, Flood protection, Control structures, Dam failure, Overflow, Rain water, Water injury, Rivers, Floodways, Dam construction, Concrete structures, Downstream, Snowmelt, Impoundments, Utilities.

Plaintiffs, lower stream proprietors, owned cottages about a mile below a dam owned by the defendant utility company. Plaintiffs' cottages were destroyed when heavy rains and melting snow flooded the valley. Plaintiffs sought recovery for property damage resulting from the alleged negligent construction and operation of defendant's dam. Defendant contended the damage was caused by an act of God - an unprecendented flood. The Connecticut Supreme Court affirmed a decision for defendant although acknowledging that an upper stream proprietor has no right to gather and impound waters and then suddenly release them on the land of the lower proprietors. It is the common right of all to have the stream preserved in its natural size, flow and purity without material diversion. In order to recover, the plaintiffs had to prove that the defendant substantially accelerated the flow of the water beyond the natural capacity of the stream banks. They could not recover if the waters that flowed over the dam were the same in quantity as had entered. (Powell-Florida)
W70-06875

URBAN DRAINAGE PRACTICES, PROCEDURES, AND NEEDS,
American Public Works Association, Chicago, Ill.
Herbert G. Poertner, Dr. Karl W. Wolf, and Robert L. Anderson.
Special Report No 31, Project 119, December 1966. 54 p, 2 fig, 22 tab, 9 ref, bibliography.

Descriptors: *Drainage practices, *Surface drainage, *Watershed management, *Urbanization, *Cities, *Administrative agencies, *Management, *Administration, *Drainage districts, Drainage systems, Drainage water, Storm runoff, Flood control, Legislation.
Identifiers: *Urban drainage.

This report, produced under the direction of the Urban Drainage Committee of the American Public Works Association, presents factual information on flood protection and drainage practices and policies of urban areas, with emphasis on the planning, regulatory and financing aspects. The fact-finding investigations were generally confined to the areas of management and administration. A questionnaire containing 66 questions was mailed, in 1965, to each community of the United States and Canada having populations in excess of 10,000 persons. Responses were received from 627 communities. The data received was summarized in 22 tables, by population groups, to express the percentage of communities in each population group that have adopted specific practices and policies in drainage management and administration. Tabulations of data were further broken down to depict practices and policies in communities having legally adopted drainage districts. The tables are presented under five chapter headings: (1) general information, (2) organizational patterns for urban drainage management, (3) financing of capital improvements, (4) planning and regulatory functions, and (5) design, construction and maintenance. Nineteen research projects are suggested. An extensive annotated bibliography on urban drainage and flood control is included. (Poertner-Chicago)
W70-06920

POTENTIAL IMPACT OF TUNNELS ON WATER POLLUTION AND FLOOD CONTROL IN THE CHICAGO AREA,
Metropolitan Sanitary District of Greater Chicago, Ill.
For primary bibliographic entry see Field 05G.
W70-06926

THE USE OF URBAN UNDERGROUND SPACE IN STORM WATER MANAGEMENT IN CHICAGO,
Harza Engineering Co., Chicago, Ill.
For primary bibliographic entry see Field 05G.
W70-06942

CHARACTERIZATION AND CONTROL OF OVERFLOWS FROM COMBINED SEWERS,
Engineering-Science, Inc., Forest Hills, N.Y.; and Engineering-Science, Inc., Arcadia, Calif.
For primary bibliographic entry see Field 05G.
W70-06943

MANAGEMENT OF IOWA'S WATER RESOURCES,
Office of Water Resources Research, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-06988

A FACTOR ANALYSIS OF RESERVOIR LOSSES,
Agricultural Research Service, Riesel, Tex. Soil and Water Conservation Research Div.
Walter G. Knisel, Jr.
Water Resources Research, Vol 6, No 2, p 491-498, April 1970. 8 p, 3 fig, 4 tab, 11 ref.

Descriptors: *Reservoir leakage, *Karst, *Texas, Limestones, Caves, Seepage, Statistical methods, Water storage, Groundwater movement, Water levels, Water level fluctuations, Surface-groundwater relationships.
Identifiers: Factor analysis.

Analyses of loss rates from five floodwater detention reservoirs in cavernous terrain are presented. Thirteen variables were included in a factor analysis to determine those significant for estimating reservoir loss rates. Three variables were found to be significant for one reservoir, but the accuracy of estimate of loss rate was not significantly greater than for reservoir stage alone. Loss rates are related arithmetically and by power functions to reservoir stage. The amount of variance explained

y reservoir stage ranges from 54% to 90%. Loss ates ranged up to 4.5 acre feet per hour for the five eservoirs. (Knapp-USGS)
W70-06997

THE 3-PARAMETER LOGNORMAL DISTRIBUTION AND ITS APPLICATIONS IN HYDROLOGY,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02E.
W70-06999

A STATISTICAL COMPARISON OF MEANDER PLANFORMS IN THE WABASH BASIN,
Purdue Univ., Lafayette, Ind.
T. P. Chang, and G. H. Toebes.
Water Resources Research, Vol 6, No 2, p 557-578, April 1970. 21 p, 13 fig, 3 tab, 32 ref. OWRR Project No A-003-IND.

Descriptors: *Meanders, *Alluvial channels, *Statistical methods, Model studies, Hydraulic models, Open channel flow, Geomorphology, Probability.
Identifiers: Spectral analysis, Wabash River (Indiana).

The planforms of two natural meandering rivers, the Wabash River and the White River in Indiana, were investigated using a variety of statistical techniques. Local curvature series were used as the basic statistical descriptor of the planform. Two groups of factors, (1) geology and soil and (2) flow rate and channel slope, were found to be major factors that control the meander planform. This conclusion was supported by probability distribution as well as by time series analysis studies. A method of moving spectrums was developed for the analysis of nonstationary data that are typical in geomorphology. This method was applied to the curvature series of the White and Wabash rivers. It appears to provide an objective way to describe local statistics of the meander shape. (Knapp-USGS)
W70-07003

HODOGRAPH SOLUTION OF THE DRAINAGE PROBLEM WITH VERY SMALL DRAIN DIAMETER,
Agricultural Research Council, Cambridge (England). Unit of Soil Physics.
E. G. Youngs.
Water Resources Research, Vol 6, No 2, p 594-600, April 1970. 7 p, 3 fig, 2 tab, 11 ref.

Descriptors: *Drainage, *Soil water movement, *Groundwater movement, *Subsurface drainage, Drawdown, Capillary water, Drainage systems, Mathematical studies.
Identifiers: Hodographs.

The hodograph treatment of the drainage problem of uniform vertical fluxes draining to a system of parallel equally spaced cylindrical drains laid in an infinitely deep soil is applied to the case of very small drains. A simple approximate expression allowing the inclusion of the effect of the capillary fringe thickness is derived for the drain radius. Computed results are presented, and these are used in the discussion of experimental results for systems of gappy drains laid in a hydraulic model sand tank. (Knapp-USGS)
W70-07006

SEEPAGE FROM TRAPEZOIDAL CHANNELS,
Uttar Pradesh Irrigation Research Inst., Roorkee (India).
Satya P. Garg, and A. S. Chawla.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY6, Paper 7335, p 1261-1281, June 1970. 21 p, 15 fig, 3 tab, 17 ref, append.

Descriptors: *Canal seepage, *Water levels, *Groundwater movement, *Surface-groundwater relationships, Open channels, Drainage, Flow nets, Mapping, Analytical techniques.
Identifiers: Conformal mapping.

The general problem of seepage from trapezoidal channels in homogeneous and isotropic material with drainages at a finite distance from the canal and at a finite depth is solved exactly by the use of conformal mapping. Equations for seepage discharge and the shape of the free surface are given and solved numerically. The results are given in the form of easy-to-use curves. The analysis indicates that the phreatic surface has a continuous curve from the canal to the drain. This surface rises with increase in bed width, water depth and drainage distance, though the effect of side slopes is very little. The seepage discharge increases with an increase in bed width, water depth, side slopes, and with a decrease in the drainage distance. (Knapp-USGS)
W70-07016

OHIO SURFACE WATER RIGHTS,
For primary bibliographic entry see Field 06E.
W70-07063

EFFECTS OF FOREST COVER UPON HYDROLOGIC CHARACTERISTICS OF A SMALL WATERSHED IN THE LIMESTONE REGION OF EAST TENNESSEE,
Tennessee Valley Authority, Knoxville.
For primary bibliographic entry see Field 02A.
W70-07081

KEENER V SHARP (MAINTAINING OF DAM IN NATURAL WATERCOURSE ENJOINED).

95 SW 2d 648-654 (Mo Ct App 1936).

Descriptors: *Watercourses (Legal), *Dams, *Missouri, *Surface waters, Standing waters, Sluices, Bayous, Lakes, Overflow, Impounded waters, Impoundments, Water levels, Watersheds (Basins), Mississippi River, Obstruction to flow, Overland flow, Rivers, Inflow, Runoff, Legal aspects, Water law, Judcial decisions, Remedies, Riddance (Legal aspects), Repulsion (Legal aspects).
Identifiers: *'Common enemy' rule, Continuing trespass.

Plaintiffs owned land between Morris Lake and the Mississippi River. The lake was connected with the river by a natural drain and watercourse, through which waters of the river flowed into the lake when the river rose, and flowed back into the river when the river fell. Defendants erected a sluice or dam in the drain, obstructed flow there through and caused water to stand on plaintiffs' land. Plaintiffs sought to enjoin defendants from maintaining and operating the dam. Defendants alleged that the water in the lake, as well as the overflow therefrom, was surface water, against which a landowner has the right to fight and change conditions without being liable to adjoining landowners. The court held that surface water is separated from waters in a natural body, such as a lake or river. A natural drain with well-defined banks, which is the outlet of a lake, is a natural watercourse and may be regarded as part of the lake. The overflow from the lake which was being retained by defendants was part of the lake and was not surface water. The court enjoined the maintenance of the defendants' dam as a continuing trespass. (Cuevas-Florida)
W70-07110

LOUISVILLE AND N R CO V LASWELL (INTERFERENCE WITH THE NATURAL FLOW OF WATER ONTO ADJOINING LAND).

187 SW2d 732-736 (Ky 1945).

Descriptors: *Kentucky, *Natural flow doctrine, *Riparian rights, *Railroads, Boundaries (Property), Easements, Relative rights, Riparian land, Culverts, Right-of-way, Legal aspects, Alteration of flow, Obstruction to flow, Flood damage, Damages, Overflow, Judicial decisions, Remedies, Rainfall, Landfill.

Defendant railroad company which owned a right-of-way running parallel to a creek which bounded plaintiff's property on the west, constructed a double tract over a high fill, through which it built a culvert to carry water from the high land into the creek. The owner of a strip of land between the right-of-way and the creek built a fence which extended onto defendant's land with defendant's knowledge. Plaintiff contended that the culvert was a nuisance in that it restricted the natural flow of water such that, in heavy rainfall, the water was forced rapidly through the culvert, creating a new water passage over plaintiff's land and causing overflow thereonto. Plaintiff further contended that the culvert was a temporary structure, thus not within the 5 year statute of limitation on suits for damages caused by permanent structure, and that defendant was also liable for damages caused by the fence built on its property with its knowledge. The court held that a structure which can be easily improved or changed at reasonable expense is temporary. In this case the culvert was clearly a permanent structure and the statute of limitation applied. The fence was clearly a temporary structure under the statute of limitation. (Clarke-Florida)
W70-07112

RIGGS V KETNER (PRESCRIPTIVE RIGHT TO ARTIFICIAL INCREASES IN WATER FLOW ONTO ADJOINING LANDS).
187 SW2d 287-289 (Ky 1945).

Descriptors: *Kentucky, *Prescriptive rights, *Drainage water, *Pipelines, Boundaries (Property), Judicial decisions, Legal aspects, Natural flow doctrine, Overlying proprietor, Land tenure, Relative rights, Riddance (Legal aspects), Surface water, Surface runoff, Overdraft, Pipes, Drains, Drainage systems, Sewers.

Plaintiff and defendant acquired their land from a common tract, the owner of which laid a drainage pipe from plaintiff's higher land under defendant's lower land into a public sewer. Neither party knew of the existence of the pipe until the portion under defendant's land broke, causing defendant's land to be flooded. Defendant then plugged the pipe, preventing water from plaintiff's land from draining. Plaintiff sued to enjoin defendant from maintaining the plug. The court held that despite the fact that neither party knew of the pipes' existence, a precriptive right to the use thereof became effective no later than 15 years after defendant's vendor purchased the lower tract from the original owner. Although the pipe increased the flow of water from the upper to the lower tract, the prescriptive right to such increase ripened when the statutory period, running from the date of original sale of the lower tract, expired. (Clarke-Florida)
W70-07113

CHESAPEAKE AND O RY V CARMICHAEL (RAILROAD'S NEGLIGENCE IN MAINTAINING DRAINAGE DITCH ALLEGED TO HAVE CAUSED FLOOD DAMAGE).
184 SW2d 91-93 (Ky 1944).

Descriptors: *Kentucky, *Flood damage, *Railroads, *Drainage systems, Floodwaters, Right-of-way, Ditches, Streams, Floods, Drainage, Remedies, Judicial decisions, Legal aspects, Open channels, Flood control, Overflow, Damages.

The plaintiff alleged that the railroads' failure to properly maintain a drainage ditch, along their right-of-way permitted floodwaters to overflow plaintiff's land, causing damage. The court held that it was not necessary in order to introduce evidence thereto as argued by plaintiff, for the defendant to specially plead that the flood was an act of God and not due to negligence of defendant. A general denial of negligence was sufficient to serve as a base for the introduction of evidence affirmatively showing that the flood damage was caused by something other than defendant's negligence. The court held that the evidence clearly showed that defendant's negligence was not responsible for the flood damage. Due to the extraordinary magnitude

of the flood, damage would have occurred even if the defendant's ditch had been clear. A judgment below for the plaintiff was reversed. (Caldwell-Florida)
W70-07116

ST LOUIS-S F RY V SPRADLEY (FLOOD DAMAGE FROM WATER BACKED UP BY RAILROAD EMBANKMENT).
133 SW2d 5-9 (Ark 1939).

Descriptors: *Arkansas, *Obstruction to flow, *Railroads, *Flood damage, Legal aspects, Judicial decisions, Overflow, Flood water, Buildings, Drainage, Slopes, Embankments, Roadbanks, Barriers, Culverts, Property values, Runoff, Structures, Remedies, Depreciation, Damages.

Plaintiff claimed that defendant railroad had negligently constructed its roadbed thereby backing up floodwater onto plaintiff's property. Recovery was sought for flood damage to plaintiff's inventory and to the liquor store located on his property. Defendant argued that, as the construction was of a permanent nature, the three year statute of limitations under state law started to run when the obstruction was completed. As the object causing the flooding had been in existence longer than 3 years, plaintiff's recovery was barred. The court, however, held that plaintiff could not be charged with knowledge of permanent nature of the sturcture and the extent to which damage would result therefrom. The statute of limitations therefore did not begin to run until the floods actually occurred, and did not bar the claim. However, plaintiff was held not entitled to recovery for lost profits due to inventory damage, and the court found that damages to the store must be reduced by depreciation of the building and by the fact that it had been flooded several times before. (Caldwell-Florida)
W70-07119

WESTERN UNION TEL CO V BYRD (FLOOD DAMAGE RESULTING FROM WEAKENING OF LEVEE AS A RESULT OF THE INSTALLATION OF A POLE ON IT).
122 SW2d 569-580 (Ark 1939).

Descriptors: *Arkansas, *Levees, *Water levels, *Blowouts, Flood damage, Crops, Land tenure, Overflow, Floodwaters, Bayous, Storm Runoff, Damages, Remedies, Flood control, Flood protection, Gravity, Surveys, Elevation, Topography, Measurement, Floods, Legal aspects, Judicial decisions.

Plaintiffs alleged that the defendant company had negligently placed a telegraph pole on the vrown of a bayou levee, causing the levee to rupture and flood plaintiffs' farmlands. Defendant claimed there was no negligence in the installation of the pole, and contended that, in any event, the bayou overflowed the entire levee at its highest point. This being so, defendant argued, even if its negligence caused the levee blowout, it was not the proximate cause of the flood damage, as the lands would have been flooded anyway. In support of its contention, defendant adduced elevation measurements from several flooded locations to prove the water level was higher than the highest point of the levee. Plaintiffs introduced much testimony to the effect that all the floodwaters came through the hole in the levee caused by the pole, and that the water level was at all times lower than the top of the levee. The court held that while laws of nature (water seeking its own level) controlled over conflicting oral testimony, the jury was entitled to weigh the conflicting testimony establishing the water levels in the same manner as other evidence. Therefore, a jury verdict for plaintiffs was affirmed. (Caldwell-Florida)
W70-07120

EVANS V MASSMAN CONST CO (LIABILITY OF GOVERNMENT AGENT FOR NEGLIGENT FLOODING OF RIPARIAN LAND).
115 SW2d 163-170 (Mo Ct App 1938).

Descriptors: *Missouri, *Dikes, *Federal government, *Contracts, Riparian land, Flood damage, Riparian rights, Federal jurisdiction, Condemnation, Judicial decisions, Legal aspects, Navigation, Navigable rivers, Flood control, Alteration of flow, Obstruction of flow, Levees, Check structures, Eminent domain, Remedies, Damages.
Identifiers: *Government contracts.

Defendant contractor, pursuant to a government contract for the purpose of improving navigation, built a dike partially across the Missouri River. Evidence tented to show and the trial jury found that the dike did not meet certain specifications of the contract and a War Department standing order. Unauthorized mats increased the total obstruction and retarded water flow. Moreover, the dike was constructed too close to the opposite shore. Evidence indicated that the water pressures created by the dike caused the bursting of plaintiff's levee and widespread flooding of his land. The contract stated that the federal government would not be liable for damages caused by defendant contractor in the construction of the dike. The court indicated that where improvement of navigation by an agent of the government necessarily results in damages to riparian owners, such owners may not recover from the government unless the damage is great enough to constitute a confiscation of property. Where the damage is only consequential, such damage is tortious at best, and the government is immune from suit in tort. The government agent, however, may be liable personally for such damages if he acts beyond the authority of the contract or if he acts negligently. The evidence supported a finding that plaintiff acted outside the authority of the contract and in so doing was negligent. (Clarke-Florida)
W70-07122

KEENER V SHARP (REPULSION OF SURFACE WATERS).

111 SW2d 118-121 (Mo 1937).

Descriptors: *Missouri, *Repulsion (Legal aspects), *Bayous, *Surface waters, Boundaries (Property), Riparian rights, Drainage, Judicial decisions, Legal aspects, Natural flow doctrine, Relative rights, Riparian land, Usufructuary right, Surface runoff, Drainage water, Floods, Streamflow, Watercourses (Legal), Natural streams, Dams.
Identifiers: *Water gates.

Defendant built a water gate in a bayou for the purpose of raising the water level in an adjoining lake and thereby floating timber through the lake, the bayou and ultimately into the Mississippi River. Operation of the water gate caused the water to rise on plaintiff's land from 22 inches to 4 feet. Plaintiff sought to enjoin the operation of the water gate on the ground that the bayou was a well-defined watercourse, and defendant had no right to obstruct the flow of water through it. Defendant claimed such a right under the common enemy rule on the grounds that water in the bayou was merely surface water. The court stated that Missouri followed the common enemy rule, and that a person may ward surface water off his land onto the land of his neighbor providing he dies not unnecessarily collect it and then discharge it. Also, a natural watercourse cannot be dammed and its waters diverted onto another's land causing damage to that land without compensation therefor. The court defined 'watercourse' as a natural body of water having a definite channel for the conveyance of water and through which water usually flows, though not necessarily continually. Relying on this definition, the court found the bayou to be a natural watercourse, and plaintiff's plea for an injunction was granted. (Clarke-Florida)
W70-07123

RUEHS V SCHANTZ (RIGHT OF UPHILL OWNER TO INCREASE DISCHARGE OF GROUNDWATER ONTO DOWNHILL PROPERTY BY USE OF TILE DRAINS).

15 NW2d 148-150 (Mich 1944).

Descriptors: *Michigan, *Tile drains, *Riddance (Legal aspects), *Natural flow, Saturated flow, Discharge (Water), Relative rights, Prescriptive rights, Groundwater, Groundwater management, Reasonable use, Land tenure, Water rights, Judicial decisions, Legal aspects, Remedies, Drainage systems, Soil water movement, Water table, Percolation, Subsurface drainage, Damages, Drainage effects, Drainage systems.

Defendant, an uphill landowner, proposed to construct tile drains on his property. Such drains would have concededly have had the effect of increasing the flow of water onto plaintiffs' down hill land. There was some natural flow of surface water from defendants' to plaintiffs' land, and plaintiffs did not challenge defendants' right to have this flow continue. However, plaintiffs claimed that any addition to this natural flow by a tile drainage system constituted a trespass. The court found that the effect of the drainage system would be to enable defendant to use more of his land while making more of plaintiffs' land unusable because of excess water. The court held that defendant had no right to do this and that plaintiff was entitled to an injunction against the installation of the tile drains. Defendant had the right to drain his land, but he did not have the right to do so by casting an increased flow of water on downhill property to the injury thereof. (Caldwell-Florida)
W70-07131

DRAINAGE, SOIL, CONSERVATION, ETC (WATERSHED IMPROVEMENT DISTRICTS).
Va Code Ann secs 21-112.1 thru 21-112.21 (1960), as amended, (Supp 1968).

Descriptors: *Virginia, *Drainage systems, *Watershed management, *Erosion control, Flood control, Land management, Legislation, Administration, Regulation, Conservation, Erosion, Soil conservation, Water control, Drainage districts, State governments, Local governments, Legal aspects, Taxes, Assessments, Financing, Financial feasibility, Interest, Eminent domain, Easements.

A watershed improvement district may be established within a soil and water conservation district to help prevent soil erosion. A majority of landowners within the limits of a proposed watershed improvement district may petition for such establishment. Notice and hearing concerning the need for such a district shall be held, and if a need is determined, the boundaries of such district will be defined. A referendum as to the feasibility of such district will be presented to the landowners therein, and a 2/3 vote is required for the district's creation. Administrative procedures for the creation and operation of the district are outlined. Such district is considered a governmental subdivision of the state and has the power to tax for revenue to operate the district. The district's governing body may incur indebtedness by the issuance of bonds upon a poll of the landowners. An annual tax may be levied to retire the interest on such indebtedness. The district shall have the powers of eminent domain. (Barnett-Florida)
W70-07132

LEVEE DISTRICTS ORGANIZED BY COUNTY COURT.
Mo Ann Stat secs 245.285-245.330 (1959).

Descriptors: *Missouri, *Levees, *Flood control, *Drainage systems, Dikes, Check structures, Flood protection, Multiple-purpose projects, Embankments, Retaining walls, Legislation, Local governments, State governments, Federal government, Navigable streams, Overflow, Flood plains, Drainage districts, Reclamation.
Identifiers: *Levee districts.

The term 'levee districts' shall be construed to include all districts organized for the purpose of establishing levees, dikes or reclamation improvements adjacent to any body of swamp, wet or overflowed land. County courts are empowered to divide the county into one or more districts having corporate powers. Consent of the federal government shall be obtained before undertaking improvements upon navigable streams. Proper notice shall be given of application for the establishment of a district. The board of directors may bring to the attention of the county court lands subject to overflow which are not included in a district and request their inclusion in a proper district. Levee districts may be enlarged upon approval of landowners within the district and those who are sought to be included in the enlarged district. Any levee district now existing can reorganize under the provisions of this act. (Hubener-Florida)
W70-07133

SHELL V TOWN OF EVARTS (DAM FAILURE AND IMPOUNDED WATERS).

178 SW2d 32-36 (Ky 1944)

Descriptors: *Kentucky, *Reservoirs, *Impounded waters, *Earth dams, Mine water, Dams, Judicial decisions, Legal aspects, Discharge (Water), Reservoir construction, Reservoir design, Flood damage, Water control, Flood water, Mining, Dam construction, Dam failure, Earthworks, Impoundments, Retaining walls, Washouts.

Owners of a mine licensed the defendant town to maintain and operate an improvised mine reservoir located at the top of a hill. In connection with its operation, defendant constructed a dam or retaining wall at the mouth drift of the mine in order to impound the large volume of accumulated water. Within a few months following its construction, the dam suddenly broke and the impounded lake water overflowed and damaged plaintiff's property situated in the town directly below the reservoir. Plaintiff alleged and presented testimony, in his action to recover, that the dam was negligently constructed of mud, sticks, and other improper substances, rendering it defective to restrain the accumulated water. The Kentucky Court of Appeals held that where evidence indicated that plaintiff's injury was the natural and foreseeable result of the dam's negligent construction, a directed verdict for defendant was improper. The court stated that the liability of one constructing a reservoir on his premises, which bursts, rests on the ground of negligence in constructing or maintaining the reservoir. Furthermore, where the mine owners licensed the town to maintain a dangerous reservoir on its property, the owners also become liable. (Powell-Florida)
W70-07135

INMON V CHESAPEAKE AND O RY (WATER DAMAGE FROM CULVERT DISCHARGE).
158 SW2d 147-149 (Ky 1942).

Descriptors: *Kentucky, *Culverts, *Drainage systems, *Flood damage, Discharge (Water), Judicial decisions, Legal aspects, Surface runoff, Drains, Ditches, Surface drainage, Railroads, Streams, Drainage water, Drainage effects, Conveyance structures, Highways, State governments, Land tenure, Mountains.

Plaintiff's property conisted of five dwelling houses which fronted on the south side of defendant's railroad tracks. On the north side of the tracks was a mountainside with a highway in between. Surface water flowed from the mountainside, beneath the highway, into a drain, then through a culvert under the tracks at a point opposite plaintiff's property. This culvert was connected to a wooden box drain beneath the passway separating the tracks from plaintiff's property. Water passing through the culvert and box drain was conveyed through an open ditch to a creek behind plaintiff's property. Flooding, which damaged plaintiff's property resulted when refuse filled the open ditch. Plaintiff's action for damages resulted in an adverse judgment which was affirmed. The Kentucky Court of Appeals held that where the culvert under defendant's tracks was but a single link in a drainage system constructed jointly by the state, the railroad and the plaintiff's precedecessor in title who had treated the system as a permanent one, neither the parties nor the successors in title could assert that the structure was improperly constructed so as to render the defendant liable for damage caused by water discharged by the culvert. (Powell-Florida)
W70-07136

4B. Groundwater Management

RECORDS OF OBSERVATION WELLS AND WATER-LEVEL FLUCTUATIONS IN THE ABERDEEN-SPRINGFIELD AREA, BINGHAM AND POWER COUNTIES, IDAHO, IN 1968
Geological Survey, Boise, Idaho.
H. G. Sisco.
Geological Survey mimeo report, 1970. 43 p, 17 fig, 1 tab, 15 ref.

Descriptors: *Observation wells, *Water level fluctuations, *Idaho, Water levels, Groundwater, Aquifers, Irrigation water, Hydrographs, Data collections, Hydrologic data.
Identifiers: Bingham County (Idaho), Power County (Idaho).

Records of water-level fluctuations in observation wells in the Aberdeen-Springfield area, Bingham and Power Counties, Idaho are tubulated. The main observation-well network consists of 20 wells located west of the Snake River and east of the Aberdeen and High Line Canals in an area irrigated with water from the Aberdeen Canal system. Four wells located south of the American Falls Reservoir between the City of American Falls and the Portneuf River are in an area irrigated by surface water and groundwater. Eight wells located west of the High Line and Aberdeen Canals are in areas irrigated only by groundwater pumping. The well near Ferry Butte is in an area of natural recharge in the Fort Hall Bottoms. Periodic depth-to-water measurements were made in 28 wells at approximately monthly intervals. In addition, recording gages were operated on 2 wells in Bingham County and on 3 wells in Power County. (Knapp-USGS)
W70-06732

HYDROGEOLOGICAL RECONNAISSANCE OF THE NORTH NASHWAAKSIS BASIN, NEW BRUNSWICK,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02F.
W70-06765

COARSE MEDIA FILTRATION FOR ARTIFICIAL RECHARGE,
Illinois State Water Survey, Urbana; and Tennessee Valley Authority, Chattanooga.
Robert H. Harmeson, Roger L. Thomas, and Ralph L. Evans.
Journal American Water Works Association, Vol 60, No 12, p 1396-1403, December 1968. 8 p, 4 fig, 4 tab.

Descriptors: *Artificial recharge, *Pit recharge, *Filtration, *Filters, Sands, Porous media, Infiltration, Particle size, Water quality, Water pollution sources, Water yield, Correlation analysis, Regression analysis, On-site tests, Laboratory tests.
Identifiers: Recharge water filtration.

When groundwater conditions in Peoria were approaching a critical state, study was made of various schemes for artificial recharge used in this country and abroad. Preliminary tests of the effects of artificially recharging the glacial drift aquifer were conducted in 1941 in an abandoned gravel pit near the banks of the Illinois River. Groundwater levels in the aquifer responded both rapidly and substantially. Because bacterial degradation of groundwater quality occurred in one of 4 observation wells during these preliminary tests, it was assumed that a sand filtration layer, based on water treatment practice, would be required in recharge pits to protect the groundwater from bacterial contamination. Multiple correlations and regression analysis of data provide an equation relating the variables studied. This equation can be used to indicate the filtration efficiency of coarse media with relation to the parameters of filter layer depth, coarse media diameter, and rate of recharge or to indicate the concentration of suspended solids transmitted through coarse media during artificial recharge, base on influent suspended solids concetration, rate of recharge, filter layer depth, and coarse media diameter. (Knapp-USGS)
W70-06793

ARTIFICIAL RECHARGE IN WATER RESOURCES MANAGEMENT,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering; and Texas Tech Univ., Lubbock. International Center for Arid and Semi-Arid Land Studies.
Marvin J. Dvoracek, and Sam H. Peterson.
American Society of Civil Engineers, National Water Resources Engineering Meeting, Memphis, Tennessee, January 26-30 1970, Preprint 1111. 27 p, 8 fig, 16 ref.

Descriptors: *Artificial recharge, *Groundwater recharge, *Water resources, *Water conservation, *Water supply, Water management (Applied), Natural resources, Arid lands, Semiarid climates, Southwestern U.S., Texas, Induced infiltration, Water spreading, Trenches, Pit recharge, Natural recharge, Groundwater, Irrigation water, Sediments.
Identifiers: Ogallala formation, Irrigated agriculture, Recharge wells, Recharge shafts, Rubble cones.

Water resources for arid and semiarid regions of the United States are only marginal at the present time and new sources of water are no longer available. Artificial recharge techniques are presented as one method of partially alleviating the problem. Artificial recharge is presented in the context of the water depletion of the Ogallala formation on the High Plains of Texas. There, as in the United States as a whole, irrigated agriculture is the major water user. Several recharge mechanisms are discussed, such as recharge wells, shafts, holes, pits, trenches, rubble cones, and water spreading. All of the methods share the problem of sediment content in water used for recharge, but the problem is not insurmountable. In some cases economic value of artificially recharged water has already outweighted the limitations. (Carr-Arizona)
W70-06831

SYCAMORE COAL CO V STANLEY (DESTRUCTION OF WELL BY NEARBY DRILLING).

166 AW2d 293-294 (Ky 1942).

Descriptors: *Kentucky, *Subsurface waters, *Subsurface investigations, *Relative rights, Underground streams, Land use, Land tenture, Percolation, Groundwater, Groundwater movement, Streams, Surface-groundwater relationships, Wells, Water utilization, Reasonable use, Springs, Damages, Legal aspects, Drilling, Judicial decisions, Exploitation, Coals, Coal mines.

Defendant drilled a hole on his property to determine if an underlying coal seam existed, whereupon plaintiff's well dried up. The plaintiff claimed that defendant had destroyed the underground stream of water leading to their well. The court found no evidence of a subterranean stream, stating that in any event a landowner making legitimate use of his property is not liable to the owners of adjoining lands for injuries to wells or springs fed by

hidden underground streams flowing in unknown channels. A distinction was drawn between underground streams flowing in a defined channel, which are governed by the rules pertaining to surface streams, and groundwater, which belongs to the owner of the soil in which it is found. The landowner was held to have the right to make reasonable use of the groundwater percolating beneath his property. As no malice or unreasonableness was found, defendant was held not liable. (Caldwell-Florida)
W70-06838

REPORT ON REQUIRED FACILITIES FOR REPLENISHING AND PROTECTING GROUNDWATER RESERVES IN THE CENTRAL AND WEST COAST GROUNDWATER BASINS, PART III: DOMINGUEZ GAP BARRIER PROJECT,
Los Angeles County Flood Control District, Calif.
Clinton Milne, and David R. Carrier.
May 1966. 53 p, 9 fig, 2 tab, 14 ref.

Descriptors: *Recharge, *Artificial recharge, *Groundwater recharge, *Induced recharge, *Aquifers, *Recharge wells, *Saline water intrusion, *Barriers.
Identifiers: *Los Angeles County Flood Control District, *Dominquez Gap Barrier Project.

This is the final report of a three-part investigation to determine a comprehensive corrective program of groundwater replenishement and protection for the Central and West Coast Basins. It presents the results of the studies for the prevention of seawater intrusion from San Pedro Bay into the West Coast Basin through the Dominquez Gap area. For many years, the production of groundwater for domestic and industrial use from the West Coast Basin has exceeded the natural replenishment. This overproduction has lowered the basin's water level to below sea level, causing an inland groundwater gradient from the ocean. This has caused seawater intrusion, in the Dominquez Gap area, into aquifers that are exposed to saline water. Detailed geologic and hydrologic studies were conducted within the area to determine the location, rate of movement, and route of seawater intrusion to provide a basis for the design of barrier facilities to prevent this intrusion. A recharge line is recommended along the area of hydraulic mergence betweeen the Gaspur zone and the 200-foot sand aquifer to prevent the already intruded seawater from moving into the 200-foot sand zone. It was recommended that the $3,916,000 project begin in fiscal year 1966-67 and be completed in 1969. (Poertner-Chicago)
W70-06917

RECHARGE OF GROUNDWATER FROM RENOVATED SEWAGE EFFLUENT BY SPRAY IRRIGATION,
Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics.
Richard R. Parizek, and Earl A. Myers.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p426-443, 5 fig, 1 tab, 11 ref.

Descriptors: *Groundwater recharge, *Sewage effluents, *Nutrients, *Water quality, *Irrigation, Agronamic crops, Forest soils, Evapotranspiration, Surface waters, Drainage, Infiltration.
Identifiers: *Reuse, *Return, *Renovation.

Because there are potential problems encountered in discharging sewage treatment plant effluent into a natural water course, namely increased plant growth unfavorable to fish and groundwater depletion, attention should be directed toward alternatives. It is suggested here that the alternatives should include the basic principles embodied in the renovation-conservation cycle. Four aspects of this cycle are considered: Return, Renovation, Recharge, and Reuse. In order to achieve high quality groundwater recharge, adequate treatment must be insured. This requires the uniform distribution of an appropriate rate per hour and amount per week of effluent return to a non-deteriorating, efficient renovation zone. Sprinkler irrigation on field crops and forested areas was found to be most successful with rates of 1/4 inch per hour, most frequently amounting to 2 inches per week. This was satisfactory even at -12 deg F. It was found that renovation was possible with biologically, physically, and chemically active surface soil and agronomic forest crops doing an excellent job of removing and assimilating effluent nutrients. Winter irrigation requires that nutrients not be added faster nor in greater amounts that can be adsorbed and retained within the upper soil profile for summer use. Under the ideal conditions detailed, 85-90 per cent of the effluent returned can be recharged. However, not all areas will permit significant recharge. To make room for recharge and to insure renovation, one must frequently consider groundwater reuse. Several means of reuse are discussed. (Preckwinkle-Chicago)
W70-06953

UNCONFINED AQUIFER SEEPAGE BY CAPILLARY FLOW THEORY,
Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 02F.
W70-06978

WATER RESOURCES OF IOWA.
Iowa State Geological Survey, Iowa City.
For primary bibliographic entry see Field 06B.
W70-06981

GROUNDWATER RESOURCES OF IOWA,
Geological Survey, Iowa City, Iowa; and Iowa State Geological Survey, Iowa City.
For primary bibliographic entry see Field 02F.
W70-06984

MANAGEMENT OF IOWA'S WATER RESOURCES,
Office of Water Resources Research, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-06988

A MEAN VALUE THEOREM IN PORE PRESSURE EVALUATION BY THE METHOD OF IMAGES,
McGill Univ., Montreal (Quebec).
G. D. Ransford.
Water Resources Research, Vol 6, No 2, p 645-648, April 1970. 4 p, 2 ref.

Descriptors: *Groundwater movement, *Pore pressure, Equations, Drainage, Permeability, Laplaces equation, Porous media.
Identifiers: Method of images.

It is shown that mean pore pressure measured transversally through a rectangular domain in which groundwater flow is taking place from front to rear varies linearly from one sink (or source) to another provided such sinks or sources are located on the centerline of the domain, midway between the side faces. Methods of computation of the mean pore pressure at any section are given. The specific application is to uplift evaluation in concrete dams, but the theorem applies to any problem governed by the Laplace theorem. (Knapp-USGS)
W70-07009

REGULATING GROUNDWATER IN HUMID ZONES,
Earl F. Murphy.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 55-71, 1970. 17 p, 57 ref.

Descriptors: *Subsurface waters, *Groundwater, *Water management (Applied), *Water districts, Aquifers, Surface-groundwater relationships, Regulation, Fresh water, Saline water, Saline water intrusion, Potable water, Programs, Water control, Control systems, Water conservation, Drainage water, Environmental sanitation, Water quality control, Non-structural alternatives, Economics, Administration, Water resources development, Humid areas, Humid climates, Hydrologic cycle.

The history and development of groundwater regulation are discussed. A number of problems in groundwater regulation are discussed, including: (1) the invasion of fresh water aquifers by salt water that threatens a total loss of potable water supplies; (2) the excessive demands on underground sources of water; (3) the fragmentary water management programs; and (4) the degree of constitutional protection afforded rights in groundwater as property interests under the fifth amendment. The creation of a legal system for groundwater in humid zones responsive to a totally industrialized and urbanized environment is needed for the exploitation of groundwater. Greater consolidation must be achieved in water extraction if an adequate regulatory scheme is to be developed. Enabling acts establishing groundwater districts of a size determined by the character and location of major aquifers should be passed. All interests in groundwater within the district should be conveyed by the landowners to the district so that the costs of groundwater use can be minimized and the benefits maximized. Water districts reduce desiccation of underground water sources, conserve drainage water, and provide information about subsurface hydrology. (See also W70-07095). (Powell-Florida)
W70-07099

FELDHAUS V JEFFERSON COUNTY (DIFFERENCE BETWEEN PERCOLATING WATER AND UNDERGROUND STREAM).
95 SW2d 790-792 (Ky 1936).

Descriptors: *Kentucky, *Springs, *Subsurface waters, *Underground streams, Drainage, Local governments, Spring waters, Water supply, Damages, Legal aspects, Water sources, Drainage systems, Groundwater, Groundwater basins, Surface-groundwater relationships, Percolation, Percolating water, Subsurface drainage, Ditches, Deep percolation, Judicial decisions, Relative rights, Obstruction to flow, Alteration of flow.

The plaintiff claimed that defendant county, in constructing a drainage ditch, had cut an underground stream which fed a spring on her property causing the spring to dry up. The court drew a distinction between underground percolating water, in which the owner of the land above has an absolute right of use and appropriation, and underground streams. Because of the nature of the terrain any underground stream necessarily had to be very deep, and the court found no evidence that the county's drainage ditch had been cut deep enough to interfere with the flow of any possible stream. A judgment for the defendant county was affirmed. (Caldwell-Florida)
W70-07109

4C. Effects on Water of Man's Non-Water Activities

AN ECOLOGICAL STUDY OF THE TWIN CITIES METROPOLITAN AREA,
Metropolitan Council of the Twin Cities, Minn.
For primary bibliographic entry see Field 06G.
W70-06764

NUTRIENT LOSS ACCELERATED BY CLEARCUTTING OF A FOREST ECOSYSTEM,
Yale Univ., New Haven, Conn.; Dartmouth Coll., Hanover, N. H.; Geological Survey, Washington, D. C.; and Forest Service (USDA), Durham, N. H.
F. H. Bormann, G. E. Likens, D. W. Fisher, and R. S. Pierce.

Science, Vol 159, p 882-884, February 23, 1968. 3 p, 1 fig, 1 tab, 14 ref. NSF Grants GB 1144, GB 4169, GB 6757, and GB 6742.

Descriptors: *Clear-cutting, *Leaching, *Nutrients, *Soil-water-plant relationships, Small watersheds, Nitrates, Runoff, Vegetation effects, Nitrification, Ecology, Eutrophication, Water pollution sources.
Identifiers: Nutrient losses.

The forest of a small watershed-ecosystem was cut in order to determine the effects of removal of vegetation on nutrient cycles. Relative to undisturbed ecosystem, the cut ecosystem exhibited accelerated loss of nutrients: nitrogen lost during the first year after cutting was equivalent to the amount annually turned over in an undisturbed system, and losses of cations were 3 to 20 times greater than from comparable undisturbed systems. Possible causes of the pattern of nutrient loss from the cut ecosystem are discussed. (Knapp-USGS)
W70-06796

INCREASED PRECIPITATION FROM URBAN-INDUSTRIAL EFFECTS,
Illinois State Water Survey, Peoria.
Stanley A. Changnon, Jr.
Paper presented at the Annual and Environmental Meeting of the American Society of Civil Engineers, Chicago, October 13-17, 1969; Preprint 1015. 14 p, 1 fig, 1 tab.

Descriptors: *Precipitation, *Thunderstorms, *Weather, *Weather patterns, *Rainfall disposition, *Distribution patterns, *Rain gages, *Rainfall, *Storms, *Weather modification, *Urbanization, *Meteorological data, *Weather data, Winds, Snowfall, Storm structure, Orography, Industrial wastes, Industrial plants, Cities, Convection, Atmosphere, Hail, Cloud seeding.
Identifiers: *Urban effects, *Industrial effects.

The increases in urban-produced precipitation of four various sized midwest cities and two large eastern cities are discussed. Climatic studies have shown apparent urban produced precipitation increases ranging from 5 to 16 percent in annual precipitation and rain days, with 7 to 22 percent increases in summer thunderstorm days. Within the past 25 years, in an area downwind of Chicago, increases in precipitation have shown substantially greater increases, 31 to 246 percent. Little research has been done on this topic due to the sparsity of precipitation stations and inadequate instrumentation. Recent developments of airborne nuclei measuring instruments have led to isolated studies of condensation and freezing nuclei over several urban areas. In the midwest (highly industrialized Chicago, St. Louis, and the much smaller Champaign-Urbana, Illinois) studies showed a distinct maximum centered in or to the east of the cities. This supports the theory of urban produced increases on the prevailing eastward moving precipitation systems. Similar increases in precipitation were noted for Tulsa, Washington, D.C., New York and much greater increases in La Porte, Ind. (Poertner-Chicago)
W70-06918

COASTAL ENGINEERING ASPECTS OF AN AIRPORT IN LAKE MICHIGAN,
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 08D.
W70-06921

INCREASES IN WATER YIELD FOLLOWING CLEAR-CUT LOGGING IN THE PACIFIC NORTHWEST,
US Forest Service (USDA), Corvallis, Oreg. Pacific Northwest Forest and Range Experimental Station.
For primary bibliographic entry see Field 03B.
W70-07007

OHIO SURFACE WATER RIGHTS,
For primary bibliographic entry see Field 06E.
W70-07063

RESEARCH NEEDS REGARDING SEDIMENT AND URBANIZATION,
Geological Survey, Fort Collins, Colo. Water Resources Div.
For primary bibliographic entry see Field 02J.
W70-07093

4D. Watershed Protection

BANK STABILIZATION IN SUSQUEHANNA RIVER BASIN,
Corps of Engineers, Baltimore, Md. Basin Planning Branch.
James E. Crews.
ASCE Proceedings, Journal of the Waterways and Harbors Division, Vol 96, No WW1, Paper 7061, p 87-95, February 1970. 9 p, 12 fig, 2 tab, 8 ref.

Descriptors: *Bank erosion, *Stream erosion, *Bank stabilization, *Erosion control, *Pennsylvania, Stabilization, Riprap, Scour, Slope stabilization, Gabions.
Identifiers: *Susquehanna River basin.

Steambank erosion is a major problem in the Susquehanna River basin and results in continual losses or deterioration of productive lands through progressive scouring or natural channel relocations across oxbow bends. The major erosion problems within the basin occur above Sunbury, Pennsylvania, the confluence of the West Branch and main stem of the Susquehanna River. These problems include erosion to farm lands and erosion that causes structural damage to bridge abutments, retaining walls and buildings. The study of streambank stabilization within the Susquehanna River basin, was limited to the continuous type of protection such as riprap or a flexible, durable, relatively impermeable mattress. Riprap and gabions were found to be the most economical means of providing protection against caving streambanks. (Knapp-USGS)
W70-06733

EROSION AND RIPRAP REQUIREMENTS AT CULVERT AND STORM-DRAIN OUTLETS,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08A.
W70-06753

ERODED SOILS OF THE LOWER SWANSEA VALLEY,
University Coll. of Swansea (Wales). Dept. of Geography.
For primary bibliographic entry see Field 02J.
W70-06772

BIOTIC REGULATION OF PARTICULATE AND SOLUTION LOSSES FROM A FOREST ECOSYSTEM,
Yale Univ., New Haven, Conn. School of Forestry; and Dartmouth Coll., Hanover, N.H. Dept. of Biological Science.
For primary bibliographic entry see Field 02J.
W70-06778

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

COLIPHAGES AS VIRUS INDICATORS IN WATER AND WASTEWATER,
Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.
Y. Kott, and N. Buras.
Federal Water Pollution Control Admin, and Technion Research and Development Foundation, Ltd, Haifa, April 1970. 50 p, 2 fig, 9 photo, 17 tab, 32 ref. FWPCA Research Grant 16030 DQN.

Descriptors: *Bioindicators, *Coliforms, *Bacteriophage, *Enteric bacteria, *Viruses, Water pollution, Water pollution control, Aquatic microbiology, Pollutant identification.
Identifiers: Enteroviruses.

Studies were made of identification of E. coli by using specific bacteriophages, and of using bacteriophage concentrations to make quantitative estimates of coliforms and enteroviruses. The use of 73 newly isolated bacteriophages gave satisfactory results. The bacteriophage mixtures showed to yield 70-90 per cent lysis in E. coli strains isolated from water and wastewater samples. The application of concentrated E. coil bacteriophage to M-Endo or MmFC showed very good results. The proposed test for counting various coliforms is done by filtering the water sample simultaneously through two filters. In the first E. coli, A. aerogenes and other coliforms are counted, the other one is exposed to E. coli bacteriophage. Here the total bacterial count is equivalent to that of the first filter less the lysed E. coli bacteria. (Knapp-USGS)
W70-06738

BIOCHEMICAL OXYGEN DEMAND, DISSOLVED OXYGEN, SELECTED NUTRIENTS, AND PESTICIDE RECORDS OF TEXAS SURFACE WATERS, 1968,
Geological Survey, Austin, Tex.
Alton J. Dupuy, Douglas B. Manigold, and Jean A. Schulze.
Texas Water Development Board Report 108, February 1970. 37 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Water pollution, *Monitoring, *Dissolved oxygen, *Pesticides, *Texas, Sampling, Data collections, Water quality, Water pollution effects, Nitrates, Biochemical oxygen demand, Nutrients, Phosphates, Water temperature, Surface waters.
Identifiers: Water quality monitoring.

Data-collection networks for BOD (biochemical oxygen demand), dissolved oxygen, and selected nutrients and for pesticides were established in 1968 to provide information on the quality of surface waters of the State. Data collected through September 1968 at 58 BOD and nutrient stations and at 26 pesticides stations in the network are given in tables. The data were collected principally at selected existing streamflow gaging stations throughout the State, most of which are sites where additional chemical quality data are collected on a continuous, daily, or periodic basis. (Knapp-USGS)
W70-06749

FLUORESCENT PROBES IN THE DEVELOPMENT OF NEW ANALYTICAL METHODS FOR DETECTION OF WATER POLLUTION,
Georgia Univ., Athens. Dept. of Entomology.
Chester M. Himel.
Available from the Clearinghouse as PB-191 812, $3.00 in paper copy, $0.65 in microfiche. Georgia University Annual Report, June 1969-May 1970. 12 p, 1 fig. FWQA Project 16020 EAO --- 5/70.

Descriptors: *Water pollution, *Insecticides, *Fluorometry, *Analytical techniques, Tracers, Water analysis, Tagging, Dye releases, Enzymes, Monitoring, Spectroscopy, Pollutant identification.
Identifiers: Water pollution detection.

The application of fluorescent probe-enzyme systems to detection of water pollution by insecticides was studied to determine the scientific and practical feasibility of this new concept. Many suitable fluorescent probe molecules can be synthesized. In combination with serum cholinesterase enzyme, these fluorescent probe-enzyme systems give a significant spectroscopic response in the presence of insecticides. A total of 18 new candidate fluorescent probe molecules were synthesized. Of those tested, 4 are useful probe molecules. (Knapp-USGS)

W70-06754

CHEMICAL CONTAMINANTS FOUND IN SURFACE AND SUBSURFACE WATER AS RELATED TO SOIL AND CLIMATIC CONDITIONS,
Maine Univ., Orono.
Eliot Epstein, and Roland A. Struchtemeyer.
Available from the Clearinghouse as PB-191 811, $3.00 in paper copy, $0.65 in microfiche. Main University Water Resources Center Project Completion Report, August 1969. 28 p, 10 tab, append. OWRR Project No A-006-ME.

Descriptors: *Insecticides, *Pesticides, *Pesticide residues, *Soils, *Maine, Clays, Clay minerals, Organic matter, Adsorption, Path of pollutants, Runoff, Water pollution sources, Persistence, Soil contamination, Water quality, DDT, Endrin.
Identifiers: Endosulfan.

Runoff was collected from plots maintained under various cropping systems and analyzed for pesticides and various elements by electron capture gas chromatography, atomic absorption, and colorimetry. The concentration and amounts of endosulfan, endrin and DDT were lower in runoff from a rotation system of potatoes, sugarbeets and peas than from continuous potatoes. The amounts of insecticides in runoff were small compared to the amount applied. Less than 1% of the amounts applied were in water, while the concentrations of insecticides were considerably higher in the soil or sediment fraction of the runoff. Insecticides tend to concentrate in the 0.08-0.5 micron clay fraction. Intact Marshall soil retained more of each insecticide than Caribou soil, probably because of higher organic matter content in Marshall soil. In the clay fraction the retention was higher in the Caribou soil. (Knapp-USGS)
W70-06756

TRACE-ELEMENT CONTAMINATION OF PARKLANDS IN URBAN AREAS,
Edinburgh Univ. (Scotland). School of Agriculture.
D. Purves, and E. Jean Mackenzie.
Journal of Soil Science, Vol 20, No 2, p 288-290, September 1969. 3 p, 2 tab, 14 ref.

Descriptors: *Soil chemistry, *Trace elements, *Urbanization, *Air pollution effects, Path of pollutants, Copper, Boron, Soil chemical properties, Geochemistry, Air pollution.
Identifiers: Soil contamination, Edinburgh (Scotland).

There are so many possible sources of trace-element contamination in urban gardens that it is difficult to determine the relative contributions made by various kinds of human activity in urban areas. Since urban parklands are subject to much less direct interference than cultivated gardens, a study of the trace-element composition of soils and herbage from such areas and from permanent pastures in rural areas should give a more valid comparison between urban and rural soils in general. Twelve representative samples of soil from parklands within the Edinburgh City boundary and the same number of samples from permanent pastures in the surrounding rural areas in the Lothians were analyzed. Corresponding samples of herbage were taken by clipping at each site and analyzed with respect to the same elements. All sampling was done during the first two weeks of June. Soils in urban parklands are markedly contaminated with Cu, B, Pb, and Zn. Herbage from the same areas contains significantly higher levels of Pb and Zn than herbage from permanent pastures in rural areas. (Knapp-USGS)
W70-06770

SABINE RIVER AUTHORITY OF TEXAS, WATER QUALITY STUDY,
Forrest and Cotton, Inc., Dallas, Tex.
T. C. Forrest, and J. A. Cotton.
In: Preceedings, National Estuarine Pollution Study Public Meeting, Orange, Texas, October 10, 1968. 22 p, 7 fig.

Descriptors: *Water quality, *Texas, *Louisiana, *Estuaries, Water management (Applied), Saline water intrusion, Water chemistry, Water pollution sources, Water pollution effects, Dissolved oxygen, Hydrogen ion concentration, Water temperature, Chlorides.
Identifiers: Sabine River (Tex-La).

Data are presented on dissolved oxygen, pH, temperature, and chlorides in the Sabine River, Texas and Louisiana. Other parameters were excluded for various reasons. Dissolved oxygen concentrations were generally favorable, with lower values towards the mouth of the river. There has been some decline of oxygen with time. The pH ranges are generally satisfactory throughout the river. Chlorides have ranged quite high in the upper reaches, but this situation has improved and now seems under control. Near the mouth a salt wedge intrudes for some distance; its effect can be demonstrated by a graphical model. Overall water quality is good in the Sabine, but there are indications that it has declined slightly as the river receives more use. Pollution control and quality regulation should be part of the future management operation. (Knapp-USGS)
W70-06798

Eh AND pH OF OILFIELD WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
For primary bibliographic entry see Field 02K.
W70-06804

RAPID DETERMINATION OF CADMIUM AND COPPER IN PLATING WASTES AND RIVER WATER BY ATOMIC ABSORPTION SPECTROSCOPY,
Missouri Univ., Kansas City. Dept. of Chemistry.
James L. Robinson, Russell G. Barnekow, Jr., and Peter F. Lott.
French and German summaries included. Atomic Absorption Newsletter, Vol 8, No 3, p 60-64, May-June 1969. 5 p, 3 fig, 5 tab, 28 ref. OWRR Project A-009-MO.

Descriptors: *Water analysis, *Trace elements, *Copper, *Spectroscopy, Industrial wastes, Analytical techniques, Chemical analysis, Laboratory tests.
Identifiers: Atomic absorption spectroscopy, Plating wastes.

A method for the extraction and concentration of cadmium and copper from plating wastes and river water is described. The metals are extracted with 2-mercapto-benzothiazole into n-butyl acetate. They are determined in the extract by atomic absorption spectroscopy using the method of standard additions. (Knapp-USGS)
W70-06806

PARATHION - USE OF BLOOD CONCENTRATION TO DIAGNOSE MORTALITY OF FISH,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
Donald I. Mount, and Harvey W. Boyle.
Environmental Science and Technology, Vol. 3, No. 11, p 1183-1185, nov 1969. 2 tab, 2 fig, 9 ref.

Descriptors: *Fishkill, *Pesticide toxicity, Organophosphorus pesticides, Bullheads, Bioassay, Gas chromatography, Animal metabolism, Persistence, Spectroscopy.
Identifiers: *Parathion, Ictalurus nebulosus, Blood analyses, Acute exposure.

The need for methods to diagnose the cause of fish-kills is discussed. These researchers propose the measurement of parathion blood concentrations to detect fishkills caused by acute exposures to parathion. Ictalurus nebulosus were exposed to various concentrations of parathion (from .015 to 2.0 mg/l) dissolved in water for time periods of up to 30 days. Blood samples were taken and analyzed by hexane extraction after freeze-thawing and by trichloroacetic acid precipitation. Both methods gave comparable recoveries. The concentration of parathion in the blood and in the water is closely related and can be used to predict death due to acute toxicity. After a 30-day exposure, only those fish in 0.015 mg/l appeared normal. Those in 0.03 mg/l had tremors at times. The author's feel that the presence of unaltered parathion in cold-blooded vertebrates (fish) should be studied further to determind if there is a significant accumulation in such animals. (Sjolseth-Washington)
W70-06832

GAS-LIQUID CHROMATOGRAPHIC TECHNIQUES FOR PETROCHEMICAL WASTE WATER,
Union Carbide Corp., South Charleston, W. Va.
William J. Sugar, and Richard A. Conway.
Journal of the Water Pollution Control Federation, Vol 40, No 9, p 1622-1631, Sept 1968. 8 fig, 4 tab, 10 ref.

Descriptors: *Water analysis, *Chromatography, *Industrial wastes, *Organics, Spectrometers, Columns, Waste treatment.
Identifiers: *Petrochemical, Carbowax 20M, Volatile acids.

This study was made to extend recently published gas-liquid chromatographic techniques for identifying and measuring organics occurring as complex mixtures. Direct aqueous injection was practiced over a range of 1-100 mg/l. For general utility in analyzing petrochemical waste organics a 10 ft, 1/8 in. CARBOWAX 20 M column was selected. ATERGITOLE E68 substrate coupled with mass spectrometric and infrared identification of eluted components were used for conformitive purposes. For trace organic acid analysis, both (1) on-column injection into a CARBOWAX 20M column acid washed with terephthalic acid and (2) use of carrier gas wetted with CuSO4 . 5 (H2O) were necessary to eliminate ghosting. These procedures give suitable sensitivity and resolution, linear responses, insignificant base line noise, little peak tailing, and minimum ghosting. (Hancuff-Texas)
W70-06867

THE VOLUMETRIC DETERMINATION OF SULFATE IN WASTE WATERS (IN RUSSIAN),
Yu. F. Lotoshnikov, and O. N. Kukisheva.
Khimicheskie Volokna, No 1, p 72, 1968.

Descriptors: *Analytical techniques, *Sulfates, Volumetric analysis, Water analysis, Textiles.
Identifiers: *Textile mill wastes.

Sulfate-ion in textile waste water was determined with a relative error of <2% by a rapid volumetric procedure. Five drops of 0.2% aqueous alizarin red was added to a waste water sample containing 0.1-15 g. of sulfate-ion, and the sample was acidified by addition of acetic acid. If an inorganic acid was present it was first neutralized with sodium hydroxide. Ethyl alcohol was added, and the sample was titrated with 0.1 barium chloride. The analysis took approx. 15 min. The presence of < or =20-5 g. of zinc ion/l > or =100 mg. of ferric ion/l, or < or =10 mg. of aluminum ion/l did not interfere. (Work-North Carolina State Univ)
W70-06892

CONCENTRATION OF VIRUSES FROM SEWAGE AND EXCRETA ON INSOLUBLE POLYELECTROLYTES,
Baylor Univ., Houston, Tex. Coll. of Medicine.
Craig Wallis, Saul Grinstein, Joseph L. Melnick, and Joseph E. Fields.
Applied Microbiology, Vol 18, No 6, p 1007-1014, December 1969. 1 fig, 7 tab, 11 ref.

Descriptors: *Viruses, *Sewage, *Adsorption, *Methodology, Analytical techniques.

Identifiers: *Excreta, *Polyelectrolytes, Concentration, Detection.

The soluble cross-linked copolymer of maleic anhydride is described. It is reported to adsorb purified viruses avidly and selectively concentrate virus from crude culture in the presence of organic materials with quantitative recovery of the virus by elution. The objective of this study is the detection of viruses in sewage and human excreta comparing different concentration methods. The insoluble polyelectrolyte method was found to be most advantageous for recovering viruses from natural waters since it could be used to treat very large volumes of fluid more efficiently and economically than other methods with which it is compared. Viruses, either added to sewage or naturally contained in sewage, were preferentially adsorbed to this polyelectrolyte at a pH of 5 to 6 and were eluted at pH 8 and 9. Methods of virus recovery compared in this study were: aluminum hydroxide, cellulose membrane and insoluble polyelectrolyte. (Hancuff-Texas)
W70-06912

INNOVATION IN MEMBRANE FILTER TECHNIQUE AS APPLIED TO WATER BACTERIOLOGY,
Denver Board of Water Commissioners, Colo.
William R. Van Nattan.
Typescript, 1969. 7 p, 1 tab.

Descriptors: *Microbiology, *Bacteria, *Membranes, *Filters, *Membrane processes, *Sewage bacteria, *Water pollution sources, Coliforms, Cultures, Laboratory tests.
Identifiers: *Water bacteriology.

New techniques in microbiological analysis of water are described. In a three-year study using the Membrane Filter Technique, over 35,000 potable water samples were processed and analyzed. Samples coming into the laboratory at a rate of 40 to 80 per day required an efficient system of collection, analysis and record-keeping to handle the load. The Membrane Filter Technique can process a relatively large volume of water with the assurance that all significant bacteria will be retained on the surface of the membrane for analysis. The testing area is kept 'clean' by an air filtration system. All equipment and tools are sterilized. Three types of culture media are used for detection of pollution. M-Endo broth is used for detection of coliform bacteria. Fecal-coliform broth detects the presence of a more recent pollution than coliforms, Enterococcus agar is used to indicate fecal Streptococci (animal intestinal waste). One objection to the Membrane Filter for water analysis is that the filter becomes plugged when processing turbid waters containing sediments; a method has been developed to transfer the growth from the turbid membrane. (Poertner-Chicago)
W70-06914

TRACE ELEMENTS AND THEIR ORIGIN IN A METROPOLITAN WASTE WATER EFFLUENT,
Clair G. Farnsworth.
Board of Water Commissioners, Denver, Colo, 1969. Typescript, 22 p, 1 fig, 6 tab, 7 ref.

Descriptors: *Trace elements, *Domestic water, *Water chemistry, *Water quality, *Water reuse, *Elements, *Water sources, *Waste water treatment, Laboratory tests.
Identifiers: *Denver.

This study was undertaken to determine what effects domestic use has on concentrations of trace elements found in a water system such as in Metro-Denver. The elements considered were: arsenic, barium, bromine, chromium, columbium, copper, iron, lead, manganese, molybdenum, nickel, rubidium, silver, strontium, tin, titanium, tungsten, uranium, yttrium, zinc and zirconium. The primary task was to identify trace elements found in Denver's raw water sources and compare concentrations with those of treatment plant effluents. Chemical analyses were made of all water sources that contribute to the effluent of the Denver Sewage disposal Plant No. 1. These included wells, springs and mountain streams west to Denver. Composite water samples representing three days collection were dried to a solid residue. They were then weighed and ignited to 1000 deg C for one hour to determine L.O.I. (loss on ignition). They were weighed again and loss of weight was calculated as percent L.O.I. The remainder of each sample was termed 'inorganic solids' and this portion was used for chemical analysis. The investigator found that the trace elements occur in the raw waters in detrimental concentrations only in the regions of origin. In such areas, greater treatment of water for comestic consumption is required. Trace elements in raw waters tend to remain in solution throughout domestic use. (Poertner-Chicago)
W70-06915

DETERMINATION OF FLUORINE BY MICRO DIFFUSION AS APPLIED TO WASTE WATERS, RIVER SAMPLES AND EFFLUENTS,
Upper Tame Main Drainage Authority, Birmingham (England).
A. E. Hey, and S. H. Jenkins.
Water Research, Vol 3, No 12, p 901-906, 1969. 1 fig, 17 ref.

Descriptors: *Analytical techniques, *Fluorine, *Water analysis, Water pollution, Industrial water, Rivers, Waste water (Pollution), Water properties, Diffusion.
Identifiers: *Micro-diffusion technique, Alizarin complexan method, Polyproplylene cell, Hexamethyldisiloxane.

This new method for the determination of fluorine in samples of waste waters, river waters, and industrial effluents employs micro-diffusion technique for the separation and concentration of fluorine. The content of the element is then determined by the alizarin complexan method. (Wilde-Wisconsin)
W70-06970

A SYSTEM FOR THE ANALYSIS OF DISSOLVED OXYGEN, NITROGEN AND ARGON IN NATURAL WATERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 02K.
W70-07030

SOME MEASUREMENTS OF TOXICITY OF TANNERY AND TEXTILE WASTES AND THEIR COMPONENTS TO FISH BY BIO-ASSAYS,
For primary bibliographic entry see Field 05C.
W70-07047

VOIDANCE TIME FOR 23 SPECIES OF FISH,
Bureau of Sport Fisheries and Wildlife, Warm Springs, Ga. Southeastern Fish Control Lab.
Thomas H. Lane, and Howard N. Jackson.
For sale by the Superintendent of Documents, U.S. Government PRINTING Office, Washington, D.C., 20402 - Price $0.35. In: Investigations in Fish Control, Report No. 33, 9 p, 1969. 4 tab, 2 figs, 14 refs.

Descriptors: *Bioassay, Colorimetry, Fish pysiology, Digestion, Animal metabolism, Sunfishes, *Analytical techniques, Fish diets, Fish, *Laboratory equipment.
Identifiers: *Voidance time, *Digestion rates, Sudan 111, Water temperature effects.

Observations on 23 species of fingerling-size bioassay fish indicated that voidance time (time required for food residues to pass through the alimentary canal) ranged from 12 to 108 hours. The period of time that fingerling-size fish should be held off feed before use in bioassays depends principally on the species, type of food, and temperature. If contamination of bioassays by food-waste feces is to be minimized, food should be withheld from most of the 23 species studied for 2 to 3 days before bioassays. (See also W70-07146 and W70-07148) (Sjolseth-Washington)
W70-07147

5B. Sources of Pollution

BIOCHEMICAL OXYGEN DEMAND, DISSOLVED OXYGEN, SELECTED NUTRIENTS, AND PESTICIDE RECORDS OF TEXAS SURFACE WATERS, 1968,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 05A.
W70-06749

FARM NITRATES: NO MENACE TO THE RIO GRANDE.

Agricultural Research, Vol 18, No 10, p 3-4, April 1970. 2 p, 1 fig, 2 photo.

Descriptors: *Nitrates, *Rio Grande, *New Mexico, *Texas, Fertilizers, Water pollution sources, Water quality, Return flow, Leaching, Irrigation water.
Identifiers: Mesilla Valley (N Mex), Rincon Valley (N Mex), El Paso Valley (Tex).

As part of a 30-year study of salt-balance conditions in three irrigated areas along the river, NO3-N content was measured over a period when nitrogen fertilizer increased from almost nothing to a high level. The overall NO3-N concentration of the river did not increase, indicating no significant stream pollution by NO3-N from nitrogen fertilizer. The three irrigated areas are the Rincon Valley (17,000 acres), farther downstream the Mesilla Valley (80,000 acres), and below that the El Paso Valley (52,000 acres). Water for irrigation is taken from the Rio Grande at various diversion dams. The drainage water returns to the river above the point where water is withdrawn for the next downstream irrigated area. (Knapp-USGS)
W70-06763

THE VOLUMETRIC DETERMINATION OF SULFATE IN WASTE WATERS (IN RUSSIAN),
For primary bibliographic entry see Field 05A.
W70-06892

LIQUID WASTE DISPOSAL IN THE LAVA TERRANE OF CENTRAL OREGON,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
Jack E. Sceva.
Available from the Clearinghouse as PB-191 874, $3.00 in paper copy, $0.65 in microfiche. Report No. FR-4, May 1968. 66 p, 15 tab, 20 fig, 3 plates, 11 ref.

Descriptors: *Drainage wells, *Sewage disposal, Groundwater geology, Oregon, *Waste water disposal, Disposal, Waste disposal, Lava.
Identifiers: Deschutes River Basin, *Disposal wells, Liquid waste disposal.

A large part of the Middle Deschutes Basin in Central Oregon is underlain by basaltic lava flows that restrict the construction of conventional drain fields for liquid waste disposal. Drilled disposal wells in the lava serve as the chief method of liquid waste disposal. The disposal wells are concentrated in the Bend, Redmond, and Madras areas. THEY RANGE FROM A FEW FEET TO OVER $)) FEET IN DEPTH. Large quantities of groundwater underlie these areas and are being developed for domestic water supplies. The injection of liquid waste into disposal wells and the construction of deep uncased water wells create a threat to water quality. The prevention of further drain well construction and the casing of all deep water wells are recommended.
W70-06962

LIQUID WASTE DISPOSAL IN THE LAVA TERRANE OF CENTRAL OREGON (Appendix),
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
Jack E. Sceva.
Available from the Clearinghouse as PB-191 875, $3.00 in paper copy, $0.65 in microfiche. Report No. FR-4, May, 1968. 96 p, 15 tab.

Descriptors: *Drainage wells, *Sewage disposal, Groundwater geology, Oregon, *Waste water disposal, Disposal, Waste disposal, Lava.
Identifiers: Deschutes River Basin, *Disposal wells, Liquid waste disposal.

This appendix contains tables describing water wells, disposal wells, well logs, springs, and information on the chemical character of groundwater and liquid wastes in the Middle Deschutes Basin.
W70-06963

BIODEGRADATION OF MALATHION,
Texas Univ., Arlington. Dept. of Civil Engineering; and Kentucky Univ., Lexington. Dept. of Sanitary Engineering.
Clifford W. Randall, and Robert A. Lauderdale.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 93, No SA 6, p 145-156, 1967. 7 fig, 1 tab, 14 ref.

Descriptors: *Biodegradation, *Pesticide kinetics, *Streams, Organic pesticides, Degradation (Stream), Aeration, Activated sludge, Toxicity, Acclimatization, Predation, Insect control.
Identifiers: *Malathion, Microbial degradation, Short-term toxicity, Forest Service.

The effect of Malathion on microorganisms was studied by administering 100 milligrams per liter of normal substrate at 24-hour intervals. The toxicity of the chemical to a mixed aqueous biota was related to the density of organisms present rather than volume of water. A low Malathion:organism ratio stimulated microbial activity while a ratio exceeding 1:5 inhibited respiration of the system. Aerobic organisms were capable of consuming Malathion, especially in the absence of other substrata. The chemical in stream is dissipated by aeration and is subject to biodegradation, but it may exert a short-term toxic effect. (Wilde-Wisconsin)
W70-06967

POLLUTION PROBLEMS IN IOWA,
Iowa Univ., Iowa City. State Hygienic Lab.
Robert L. Morris, and Lauren G. Johnson.
In: Water Resources of Iowa, Symposium Proceedings, Iowa Academy of Science at Univ of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, p 89-109, Jan 1970. 21 p 2 fig, 6 tab.

Descriptors: *Water pollution sources, *Water quality, *Iowa, Organic matter, Sewage treatment, Municipal wastes, Farm wastes, Pesticides, Water pollution control, Water quality control, Industrial wastes, Insecticides, Silt, Erosion.

The major sources of pollutants to the water resources of Iowa are agricultural, industrial and municipal wastes. Practically all of the urban population of Iowa is served by municipal waste treatment to an adequate extent. Most of the municipal treatment facilities on intermal streams have secondary treatment which removes 85-95% of the organic load. All of Iowa's streams are subject to standards which adequately provide for public water supply, aquatic life propagation and growth, recreation, industrial and agricultural purposes. There are over 150,000 individual farmsteads in the State of Iowa, raising cattle, hogs, sheep, and poultry, having a population equivalent (PE) far exceeding the human population of the State. The excreta from these animals produce enormous amounts of carbonaceous and nitrogenous wastes of which large portions eventually reach water courses. An extensive amount of data on the environmental conditions with respect to pesticides have been gathered. A very important aspect of stream pollution is siltation. Iowa soils dur to their peculiar structure and extensive cultivation are especially subject to erosion. (See also W70-06981). (Knapp-USGS)
W70-06987

SOME FINITE DIFFERENCE SOLUTIONS FOR THE DISPERSION OF THERMAL SOURCES IN STEADY PRISMATIC FLOW,
Rutgers - The State Univ., New Brunswick, N.J.
R. C. Ahlert, G. Biguria, and J. Tarbell.
Water Resources Research, Vol 6, No 2, p 614-621, April 1970. 8 p, 4 tab, 10 ref. Project A-019-NJ.

Descriptors: *Diffusion, *Mathematical models, *Path of pollutants, Dispersion, Mixing, Thermal pollution, Diffusivity, Turbulent flow, Turbulence, Vortices, Eddies, Steady flow, Open channel flow.
Identifiers: Boussinesq equation, Eddy viscosity.

Mathematical models and numerical difference techniques simulate the dispersion of heated effluents in steady, prismatic flow. Isovelocity point and line sources of finite volumetric flow develop in a short-time region of the order of two depths. Dispersion of plane sources and developed sources of the point or line type occurs in a longtime regime and is variable in two dimensions with respect to both velocity and diffusivity. Short-time solutions serve as input to a general longtime finite difference scheme. Flow mechanics control dispersion in typical problems employing point and plane source configurations. (Knapp-USGS)
W70-07014

NUTRIENT CYCLING,
Yale Univ., New Haven, Conn. School of Forestry; and Dartmouth Coll., Hanover, N.H. Dept. of Biological Sciences.
For primary bibliographic entry see Field 02K.
W70-07094

5C. Effects of Pollution

THERMAL ADDITIONS AND EPIFAUNAL ORGANISMS AT CHALK POINT, MARYLAND,
Geological Survey, Washington, D.C.
J. W. Nauman, and R. L. Cory.
Chesapeake Science, Vol 10, No 3 and 4, p 218-226, September-December 1969. 9 p, 7 fig, 26 ref.

Descriptors: *Thermal pollution, *Environmental effects, *Aquatic environment, *Aquatic life, *Maryland, Water temperature, Aquatic microbiology, Heated water, Thermal powerplants, Productivity, Water pollution effects.
Identifiers: Epifauna, Chalk Point (Md).

Two sets of test panels, one in the intake and the other in the effluent canal of a steam-generating station, were submerged at monthly intervals in 1967. The panels were analyzed for epifaunal species composition, abundance, seasonal attachment, and total biomass production. The average surface-water temperature rose 6.3 C above ambient on the effluent side, and biomass production of the epifaunal organisms found there increased nearly three times that of the intake. An earlier and larger set of some attached organisms occurred in the effluent, but there was little change in species composition between the intake and effluent canals. During the summer when high surface-water temperatures prevailed, there seemed to be a reduced number or disappearance of flatworms and colonial hydroids, along with increased barnacle growth. (Knapp-USGS)
W70-06782

EPIFAUNA AND THERMAL ADDITIONS IN THE UPPER PATUXENT RIVER ESTUARY,
Geological Survey, Washington, D.C.
R. L. Cory, and J. W. Nauman.
Chesapeake Science, Vol 10, No 3 and 4, p 210-217, September-December 1969. 8 p, 6 fig, 17 ref.

Descriptors: *Thermal pollution, *Environmental effects, *Aquatic environment, *Aquatic life, *Maryland, Water temperature, Water quality, Turbidity, Aquatic microbiology, Heated water, Thermal powerplants, Productivity, Water pollution effects.
Identifiers: *Upper Patuxent Estuary (Md).

In the upper Patuxent Estuary environmental changes in temperature, salinity, and turbidity over a 5-year period are linked to changes in epifaunal production and species distribution. During 1967 a series of monthly panels showed dry weight production averaged 2.8 times greater in a steam electric station heated effluent than in the intake. A downriver shift in epifaunal production in 1967 and changes in species abundance was noted and attributed to natural changes in salinity and turbidity and man-induced changes in temperature. (Knapp-USGS)
W70-06783

PARATHION - USE OF BLOOD CONCENTRATION TO DIAGNOSE MORTALITY OF FISH,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
For primary bibliographic entry see Field 05A.
W70-06832

DDT RESIDUES ABSORBED FROM ORGANIC DETRITUS BY FIDDLER CRABS,
Miami, Univ., Fla. Inst. of Marine Science.
W. E. Odum, G. M. Woodwell, and C. F. Wurster.
Science, Vol 164, p 576-577, May 1969. 1 fig, 16 ref.

Descriptors: *DDT, *Detritus, *Animal behavior, Crabs, Chlorinated hydrocarbon pesticides, Pesticide residues, Pesticide toxicity, Estuarine fisheries, Persistence, Bioassay.
Identifiers: *Fiddler Crabs, DDD, DDE.

The association of organic particulate matter in estuaries is significant because many organisms rely on such particles for food. The association of DDT residues with detritus particles of various sizes and the availability of these residues to the fiddler crab (Uca pugnax) were examined. Detritus particles from 500 to 1000 microns in diameter contained the highest DDT residues and were also the detritus ingested by many organisms. The transfer of DDT residues attached to organic detritus was studied using 45 fiddler crabs. Fifteen crabs were killed immediately; DDT residues in their claw muscle averaged 0.235 ppm. Fifteen crabs were used as controls and fed detritus containing 0.01 ppm DDT. The other 15 crabs were fed detritus containing 10.0 ppm DDT. After 10 days the control group appeared normal, but all crabs in the experimental group developed poor coordination by day 5. After 10 days the controls had .240 ppm and the experimental group had a mean DDT residue level of 0.885 ppm. (Sjolseth-Washington)
W70-06833

ANALYSIS OF MERCURY OF FISHES AND SOILS OF AGANO RIVER (IN JAPANESE),
Tokyo Science Univ., (Japan).
Shunji Ishikura, and Shibuya, Chieko.
Eisei Kagaku, Vol. 14, No. 4, p 228-230, 1968. 3 tab, 1 fig.

Descriptors: *Soil analysis, *Degradation, *Water pollution effects, Heavy metals, Water analysis, Fishkill, Photometry.
Identifiers: *Mercury, Agano river, Japan, Tissue analyses.

The analysis of mercury was carried out to clear the cause of occurrence of poisoned patients caused by organic mercury around the Agano River. The mercury content was estimated photometrically from the mercury dithizonate which was isolated from dithizon extract of oxidative degradition

product of samples such as soils, fishes and waters. It was found that the soils obtained near the draining exit of Shyowa Denko and Nippon Gas Kagaku contained high amount of mercury, whereas the mercury was not detected clearly in any waters. Some fishes were also found to keep the high concentration of the total mercury and organic mercury. (Sjolseth-Washington)
W70-06834

SPLEEN AND KIDNEY MASS - A MEASURE OF THE PHYSIOLOGICAL ACTIVITY OF THE CARP (CYPRINUS CARPIO L.) (IN GERMAN),
Marie-Luise Albrecht.
Zeitscrift fur Fischerei, NF Band 17, Heft 1-4, p 79-100, 1969. 18 tab, 1 fig, 28 ref.

Descriptors: *Fish physiology, Carp, Stress.
Identifiers: *Spleen, *Kidney, Kidney atrophy, Spleen ischemia, Osmoregulation, Organ blood content.

Studies on the changes in size of spleen and kidney in carp under different conditions of life have shown that the shape of these organs, especially that of the spleen, may change considerably. It was observed that at relative inactivity (narcotization, low water temperatures) spleen and kidney of carp are full of blood. When in summer the activity of muscles is raised these organs deliver blood to the circulation system. When exposed for a long time to higher temperatures (30 deg C) spleen ischemia and kidney atrophy become especially evident. Stresses as oxygen deficit, catching, holding and transporting in tanks also effect the blood filling rate of organs and lead to blood delivery. These processes are controlled by nerves and hormones. Outbreaks of acute infectious dropsy in carp leads to swelling of spleen and kidney caused by failure of the osmo-regulating mechanism and so the water content of organs raises. Carp react very sensitively to every physiological stimulus, this is shown i.a. by the blood content of spleen and kidney. The state of these organs, especially that of the spleen may serve as indicator for the physiological condition both of individual fish and of the entire stock. (Sjolseth-Washington)
W70-06835

THE POLLUTION ENVIRONMENT,
Federal Water Pollution Control Administration, Washington, D.C.
William Marcus Ingram, and Kenneth M. Mackenthum.
In: Proceedings of the Second Annual American Water Resources Conference, American Water Resources Association, Urbana, Ill., 1966, p. 115-133, 11 fig, 2 tab, 15 ref.

Descriptors: *Water pollution, *Water pollution effects, *Industrial wastes, *Municipal wastes, *Public helath, *Ecology, *Pollutants, *Standards, *Biochemical oxygen demand, Silts, Sewage, Textiles, Pulp and paper industry, Chemical wastes, Acid mine water.
Identifiers: *Stream ecology, *Water quality standards, *Ecological aspects, *Bear River, Utah, *Chattooga River, Georgia, *Menominee River, Michigan-Wisconsin, *East Pearl River, Mississippi, *Monongahela River, Pennsylvania, Forestry-wastes.

The effects of pollution, especially complex municipal and industrial wastes, upon the aquatic life in streams are presented. Examples of organisms that may inhabit clean and polluted waters are given. Polluted waters may stimulate organism associations that become nuisances to man, or carry disease; some species of phytoplankton have been incriminated in human reactions resulting in dysenterial disorders, systemic allergic reactions, and local allergic eruptions. Pollution affects organisms in various ways, and conversely, organisms have an effect on pollution. Those organisms that survive in a pollute environment use the pollutional material as food and in doing so exert a purification potential on the wastes. One manifestation is a reduction in biochemical oxygen demand. Biological aspects of the poilutional environment are depicted in the paper including the effects of silts and sands associated with the Bear River in Utah; sewage, textile and other industrial wastes associated with the Chattooga River in Georgia; pulp and paper wastes associated with the Menominee River in Michigan and Wisconsin; forest products and chemical wastes associated with the East Pearl River in Mississippi; and acid mine discharges associated with the Monongahela River in Pennsylvania. The effects of various types of wastes on stream organisms are illustrated by several methods of graphical presentation; a different type of presentation was made for each waste. A list of measurements that can be considered in setting criteria and/or standards to protect water quality for multiple usage is presented. (Richmond-Chicago)
W70-06852

SOME SEWAGE PROBLEMS IN EUROPE TODAY,
Instituut voor Gezondheidstechniek TNO, Delft (Netherlands). Div. of Water and Soil Research.
For primary bibliographic entry see Field 05D.
W70-06881

FISHES OF THE GREEN-DUWAMISH RIVER,
Seattle Metropolitan Municipality, Wash.
Robert I. Matsuda, Gary W. Issac, and Raymond D. Dalseg.
Water Quality Series No 4, December 20, 1968, 38 p, 4 fig, 3 tab, 6 ref, appendix.

Descriptors: *Fish populations, *Fishkill, *Water pollution effects, *Shiners, *Sculpins, *Chinook Salmon, *Fish types, Waste water, Waste water disposal, Effluents.
Identifiers: *Green-Duwamish River, *Renton Treatment Plant, *Seattle.

This is a summary of a three year (1964-1966) study of the effects of the effluents from the Renton Waste water Treatment Plant on the fishlife of the Green-Duwamish River. The study included only the four most abundant of the 30 varieties of fish found in the river--Shiner Perch, Staghorn Sculpin, Starry Flounder, and the Chinook Salmon. Since no historical study of the fishes of the river could be found, this documentation is an original report. The seasonal and yearly population fluctuations of the selected species were studied. The Shiner Perch and Staghorn Sculpin population increased. The Starry Flounder population remained constant. The number of Chinook Salmon declined at one station and was variable at the other. It was concluded that the overall effect of the Renton Water Treatment Plant on the Green-Duwamish River is not detrimental to fish and desirable aquatic organisms and that the treatment plant may have contributed to the increase in fish population of some species. As the human population increases and industries expand in the Metro Service area, requiring expansion of the Renton Treatment Plant to 10 times its present effluent discharge rate, it will be necessary to continue these studies to predict the effects of increased discharges on fish populations. (Poertner-Chicago)
W70-06913

A SURVEY OF STREAM CONDITIONING IN ISSAQUAH CREEK,
Seattle Metropolitan Municipality, Wash.
Raymond D. Dalseg, Gary W. Issac, and Robert I. Matsuda.
Water Quality Series No. 3, March 1966. 24 p, 7 tab, 7 fig, 4 ref.

Descriptors: *Eutrophication, *Ecology, *Limnology, *Biocontrol, *Water pollution sources, Nutrients, Sampling, Chemical analysis, Monitoring, Water quality, Water pollution effects, Pollution abatement, Dairy industry, Sewage effluents.
Identifiers: *Issaquah Creek, *Lake Sammamish, *Lake Washington, *Seattle.

This report is a survey of the water quality of Issaquah Creek. The creek is one of the main tributaries to Lake Sammamish which is eutrophying at a substantial rate. It was found that Issaquah Creek contributes the greatest amount of nutrients to the lake. Wastes are contributed to the stream by Darigold Dairy Products, Issaquah Sewage Treatment Plant, Lakeside Gravel, and Reid Sand and Gravel. Four sampling stations were set up by request to test Darigold's output to the creek from their treatment plant. A weekly sampling program was started in August, 1965. The multiple tube fermentation technique was used in coliform examination. Field innoculations were employed throughout the tests. Selected examinations were run for positive identification of the bacteria. It was found that the nutrient-rich effluent discharged into the stream may accelerate the eutrophication of Lake Sammamish. The completion of Metro's trunk sewer line to Issaquah in 1967 should provide the facilities to convey the effluents to Metro's Renton Wastewater Treatment Plant instead of Issaquah Creek. (Poertner-Chicago)
W70-06928

DISSIPATION OF ENDOTHALL AND EFFECTS ON AQUATIC WEEDS AND FISH,
California Univ., Davis. Dept. of Botany.
For primary bibliographic entry see Field 03F.
W70-06971

AN INTRODUCTION TO THE LIMNOLOGY OF HARTBEESPOORT DAM WITH SPECIAL REFERENCE TO THE EFFECT OF INDUSTRIAL AND DOMESTIC POLLUTION,
National Inst. for Water Research, Pretoria (South Africa).
B. R. Allanson, and J. M. T. M. Gieskes.
Hydrobiologia, Vol 18, p 77-94, 1961. 11 ref.

Descriptors: *Reservoirs, *Limnology, *Industrial wastes, *Water pollution effects, *Eutrophication, Dissolved oxygen, Hydrogen ion concentration, Epilimnion, Photosynthesis, Algae, Bottom sediments, Thermocline, Hypolimnion, Animals, Density, Iron, Phosphorus, Silica, Sampling, Chemical analysis, Physical properties, Carp, Tilapia, Temperature, Nutrients, Phytoplankton, Cyanophyta, Nitrogen, Oligochaetes, Diptera.
Identifiers: *Hartbeespoort Dam (South Africa), Transparency, Marginal vegetation fauna, Sandy bottoms fauna, Marginal vegetation, Microcystis, Anabaena, Eucyclops, Nais, Cricotopus, Austrocloeon, Enallagma, Pseudagrion, Brachythemis, Chydorus, Pleuroxus, Tanypus, Tanytarsus, Limnodrilus, Eucyclops, Alona, Chaoborus.

The correlated data of this study of water mass in South Africa contribute to knowledge of pollution effects in a reservoir. Hartbeespoort Dam is eutrophic with a low transparency developed during the past 25 years. Monomictic with complete circulation during winter months, low dissolved oxygen concentrations throughout the reservoir often result. Nutrients are contributed by the Jukskei-Crocodile River system and to a lesser degree from the Magalies River. Rises in the epilimnetic pH were mainly caused by photosynthetic activity of algae in the presence of moderately basic water. Bottom sediments in the deeper portion of the reservoir underwent rapid anaerobiasis after the establishment of a thermocline and oxycline in summer. Fauna density in the bottom sediments decreases rapidly with the establishment of the hypolimnion. Sediments are rich in iron and during summer there was an increase in the ferrous component. The soluble and acid soluble phosphorus increases in the hypolimnion after a winter minimum. Silica content is comparable with productive water masses in other parts of the world. Faunal associations are typical of other moderately basic and highly productive water in the same geographical region of South Africa. (Jones-Wisconsin)
W70-06975

PHYTOPLANKTON,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 02H.
W70-06976

POLLUTION PROBLEMS IN IOWA,
Iowa Univ., Iowa City. State Hygienic Lab.
For primary bibliographic entry see Field 05B.
W70-06987

REPORT ON THE BIOLOGICAL FINDINGS OF THE HUDSON RIVER FISHERIES INVESTIGATIONS, 1965-1968,
Hudson River Technical Committee, Cornwall, N.Y.
For primary bibliographic entry see Field 06G.
W70-07024

A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
C. Mervin Palmer.
Journal of Phycology, Vol 5, No 1, p 78-82, 1969. 5 p, 11 tab, 29 ref.

Descriptors: *Algae, *Bioindicators, *Water pollution effects, *Reviews, *Water quality, Water pollution, Organic matter, Bibliographies.
Identifiers: Pollution-tolerant algae.

A review of pollution-tolerant algae using reports from 165 authors shows that the genera and species most often referred to as significant fall into a relatively stable series. Diatoms, pigmented flagellates, green, and blue-green algae are all well represented among the pollution-tolerant genera and species. Euglena, Oscillatoria, Chlamydomonas, Scenedesmus, Chlorella, Nitzschia, Navicula, and Stigeoclonium are the most tolerant genera, and Euglena viridis, Nitzschia palea, Oscillatoria limosa, Scenedesmus quadricauda, and Oscillatoria tenuis are the most tolerant species. In some genera, for example Euglena, a single tolerant species is far more significant that all others. In other genera, as in Oscillatoria, only a slight difference distinguishes the pollution tolerance of two or more species. Algal pollution indices are presented for use in rating water samples with high organic pollution. (Knapp-USGS)
W70-07027

SOME MEASUREMENTS OF TOXICITY OF TANNERY AND TEXTILE WASTES AND THEIR COMPONENTS TO FISH BY BIO-ASSAYS,
J. David, and P. Roy.
Indian Journal of Fisheries, Vol 7, p 423-442, 1960.

Descriptors: *Fish, Chlorine, *Toxicity, Textiles.
Identifiers: *Dyehouse wastes, *Statistical analysis, Textile mill wastes, Bleaching, Dyeing, Kiering, Caustic.

During a study of pollution in the river Ganga at Kanpur, India, the toxicity of various tannery and textile waste waters were investigated by bio-assay techniques, using small carp and cat fish as the test fish. Results are tabulated showing the physical and chemical characteristics of three textile waste waters, namely kier, dye, and bleach liquors and the percentage of survival and median tolerance limits for the test fish at different concentrations of these waste waters. The results are analyzed statistically and discussed in relation to the composition of the waste waters. It is concluded that kier liquor is harmless above 19-25 times dilution and dye liquor is less harmless than kier liquor; but bleach liquor is very toxic owing to the presence of chlorine and was the only liquor which in minute concentrations proved fatal to fish. (Livengood and Work-North Carolina State Univ)
W70-07047

INFLUENCE OF MOLYBDENUM ON THE TROUT AND TROUT FISHING OF CASTLE LAKE,
California State Dept. of Fish and Game, Sacramento. Inland Fisheries Branch.
Almo J. Cordone, and Stephen J. Nicola.
California Fish and Game, Vol. 56, No. 2, p 96-108. 1970. 5 figs, 6 tab, 9 refs.

Descriptors: *Molybdenum, *Fertilization, Fertilizers, Fishfood organisms, *Fish populations, Fish harvest, Fish management, *Nutrient requirements, Productivity, Rainbow trout, Brook trout, *Fish harvest, Fishing, Zooplankton.
Identifiers: *Fish production, *Sodium molybdate, Castle Lake, California.

The addition of 35 ob. of sodium molybdate (Na2Mo4 2H2O) to Castle Lake, California, in July 1963 was followed by record yields to the angler of rainbow trout in 1966, and eastern brook trout in 1967. The increase each year was approximately 3.5 lb per acre greater than the average annual yield for the period 1960-1965. Estimated cost per additional pound of trout in the creel was less than $0.10. High survival of the 1965 year class of both species was responsible for the increased yield. Greater standing crops of zooplankton and bottom fauna very likely promoted the improved survival. Changes in growth rates of trout following fertilization were not significant. The strong 1965 year classes apparently reduced survival of subsequent year classes. Factors other than fertilization may have influenced the high survival of the 1965 year classes. These include (i) the size and condition of rainbow trout when stocked, (ii) the density of resident rainbow trout when a plant was made, and (iii) a record December 1964 flood. Because of the doubts created by these factors, a second experimental molybdenum addition has been made. (Sjolseth and Katz-Washington)
W70-07137

PESTICIDE CONCENTRATIONS IN GREAT LAKES FISH,
Bureau of Commercial Fisheries, Ann Arbor, Mich. Great Lakes Fishery Lab.
Robert E. Reinert.
Contrib. No. 371 of Great Lakes Fishery Laboratory. Pesticides Monitoring Journal, Vol. 3, No. 4, p 233-240, March 1970. 8 tab, 1 fig, 8 refs.

Descriptors: *Great Lakes, *Dieldrin, *DDT, Chlorinated hydrocarbon pesticides, *Pesticide residues, Lake Michigan, Gas chromatography, Lake Erie, Lake trout, Lake Huron, Lake Ontario, Lake Superior, Pesticide removal.
Identifiers: DDD, DDE, Alewife.

Reports on a 4 year study by Ann Arbor Great Lakes Fishery Laboratory of the Bureau of Commercial Fisheries on insecticide levels in fish from the Great Lakes. The two insecticides found in all Great Lakes fish have been DDT (DDT, DDD, DDE) and dieldrin. Fish from Lake Michigan contain from 2 to 7 times as much of these insecticides as those from the other Great Lakes. Insecticide levels calculated on a whole-fish basis show a marked difference from species to species. Within a species there is also an increase in DDT and dieldrin levels with an increase in size. If these insecticide levels are, however, calculated as ppm of insecticide in the extractable fish oil, the differences in concentration between species and the differences between size groups becomes considerably less. Laboratory experiments indicate that fish can build up concentrations of DDT and dieldrin at the parts-per-million level from parts-per-trillion concentrations in the water. (Sjolseth-Washington)
W70-07138

MARINE PHYTOPLANKTON VARY IN THEIR RESPONSE TO CHLORINATED HYDROCARBONS,
Woods Hole Oceanographic Institution, Mass.
David W. Menzel, Judith Anderson, and Ann Randtke.
Contrib. No. 2424 from Woods Hole Ocean. Inst. Science, Vol. 167, p 1724-1726, March 1970. 1 fig, 9 refs. NSF Grant GB 15103 AEC Contract AT (30-1)-3862.

Descriptors: *DDT, *Dieldrin, *Endrin, Chlorinated hydrocarbon pesticides, Pesticide toxicity, Pesticide removal, *Photosynthesis, Water pollution effects, *Phytoplankton, Diatoms, Inhibition, Inhibitors, Resistance.
Identifiers: *Marine phytoplankton, Skeletonema costatum, Dunaliella tertiolecta Coccolithus huxley, Cyclotella nana.

Photosynthesis and growth in cultures of four marine phytoplankton species, (Skeletonema costatum), (Dunaliella tertiolecta), (Coccolithus huxley), and (Cyclotella nana) isolated from different oceanic environments, were affected by three chlorinated hydrocarbons (DDT, dieldrin, and endrin) to varying extents. This ranged from complete insensitivity in Dunaliella to toxicity at concentrations of 0.1 to 1.0 part per billion of the pesticides in Cyclotella. Other forms were intermediate in their response. (Sjolseth and Katz-Washington)
W70-07139

THE CHRONIC TOXICITY OF LINEAR ALKYLATE SULFONATE (LAS) TO PIMEPHALES PROMELAS RAFINESQUE,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Newtown Fish Toxicology Lab.
Quentin H. Pickering, and Thomas O. Thatcher.
Journal of the Water Pollution Control Federation, Part I, p 243-254, Feb. 1970. 9 tab, 28 ref.

Descriptors: *Linear alkylate sulfonates, *Bioassay, *Toxicity, *Detergents, Mortality, Water pollution effects, *Lethal limit, *Growth rates, Fecundity.
Identifiers: *Chronic toxicity, *Fimephales promelas, Median tolerance limits, Biodegradation, *Hatchability, Fry survival.

The primary objective of this bioassay was to determine the chronic toxicity of Linear Alkylate Sulfonate to the fathead minnow using 'laboratory fish production index' as the measure of effect. The results of this study indicate that lethality of LAS to newly hatched fry was the most critical factor found within the precision of testing methods. An experimental concentration of 0.63 mg/1 LAS was determined as the maximum acceptable concentration. The application factor for LAS for this species and water lies between 0.63/ 4.35 and 1.2/4.35 or approximately 14 and 28percent of the 96-hr TLm value. A LAS concentration between 14 and 28 percent of the 96-hr TLm value concentration, determined with the species of concern may estimate the maximum acceptable concentration for long-term exposure of these species. This application factor for LAS was the largest of any toxicant studied at the Newtown ish Toxicology Laboratory. (Sjolseth-Washington)
W70-07140

AN ANALYSIS OF VARIATION OF INSECTICIDE RESIDUES IN LANDLOCKED ATLANTIC SALMON (SALMO SALAR)
Maine Dept. of Inland Fisheries and Game, Augusta.
Richard B. Anderson, and Owen C. Fenderson.
Journal of the Fisheries Research Board of Canada, Vol. 27, p 1-11, 1970. 4 tab, 2 fig, 8 refs.

Descriptors: Maine, *Atlantic Salmon, *Pesticide residues, Pesticides, Variability, *DDT, Chlorinated hydrocarbon pesticides, *Evaluation, *Dieldrin, Water pollution effects, *Analytical techniques, Age.
Identifiers: *Sebage Lake, Maine, *DDD, *DDE, *Analysis of variance fat content.

High variation in yearly samples of insecticide residues found in landlocked salmon from Sebago Lake, Maine, has necessitated an evaluation of

sampling methods and an investigation of causes of variation. A sample of 59 male salmon, composed of ages III+, IV+, and V+, and representing fish in poor and good body condition was collected from a spawning run in the fall of 1967 and analyzed for DDT, DDD, DDE, dieldrin, and fat content. Levels of insecticide residues were found to be highly dependent on age and fat content. DDD and DDE increased with age and fat content, and dieldrin increased with fat content. Age and fat content were interdependent in their effects on DDT levels. DDT was significantly higher in high-fat than in low-fat fish at ages III+ and IV+ but not at age V+, showing a decrease with age among fish with high fat content and remaining constant with age among fish with low fat content. It is recommended that completely random selection of fish for insecticide analyses be abandoned in favor of stratification by sex, age, and fatness. Some of the possible causes of variation in insecticide content of salmon are discussed. (Sjolseth-Washington)
W70-07141

INFLUENCE OF TEMPERATURE CHANGE ON SPONTANEOUS LOCOMOTOR ACTIVITY AND OXYGEN CONSUMPTION OF ATLANTIC SALMON, SALMO SALAR, ACCLIMATED TO TWO TEMPERATURES,
Carleton Univ., Ottawa (Ontario). Dept. of Biology.
R. H. Peterson, and J. M. Anderson.
Journal of the Fisheries Research Board of Canada, Vol. 26, p 93-109, 1969. 11 figs, 20 refs.

Descriptors: Atlantic salmon, Oxygen requirements, Water temperature, Thermal stress, *Acclimatization, *Animal metabolism, Respiration, *Fish physiology, Fish behavior.
Identifiers: *Oxygen consumption, *Temperature change, *Spontaneous locomotor activity, Standard metabolic rate, Fish activity, Temperature effects.

Measurements of the effect of rapid change in temperature on the spontaneous activity and oxygen consumption were made on Atlantic salmon underyearlings acclimated to 6 or 18 C. The new levels of imposed temperature ranged from 6 to 30 C for both acclimations. At similar test temperatures the calculated standard metabolic rate of the fish acclimated to 6C was higher than that of the fish acclimated to 18 C, up to about 23 C, where the two curves relating oxygen consumption and temperature intersect. Spontaneous activity could be separated into two phases, a transient phase occurring during the actual period of temperature change, and a stabilized phase. The transient phase was characterized by a peak in activity which was found to be correlated with the rate, rather than the amount, of the temperature change. The relation between activity in the stabilized phase and test temperature was characterized by a plateau or maximum in the general region of the previously determined selected temperature. Complete acclimation for both metabolism and activity, between 6 and 18 C, requires about 2 weeks, regardless of the direction of the temperature change. (Sjolseth and Katz-Washington)
W70-07142

EFFECTS OF TEMPERATURE AND BODY WEIGHT ON ENDOGENOUS NITROGEN EXCRETION IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),
Indiana Univ., Bloomington. Dept. of Zoology.
Jan Savitz.
Journal of the Fisheries Research Board of Canada, Vol. 26, p 1813-1821, 1969. 4 tab, 2 fig, 21 ref.

Descriptors: *Fish physiology, *Thermal stress, *Water temperature, Acclimatization, *Animal metabolism.
Identifiers: *Bluegill Sunfish (Lepomis macrochirus), Temperature effects, *Endogenous nitrogen excretion rate, effects of body weight, *Protein maintenance level.

The effects of temperature and body weight on endogenous nitrogen excretion (ENE) rate were examined for fish acclimated at 7.2, 15.6, 23.9, and 29.4-32 C. Nitrogen excretion rates were very high at the highest temperature and decreased with a decrease in acclimated temperature from 29.4-32.2 C to 15.6 C. Nitrogen excretion rates were equal at 15.6 and 7.2 C. From these data, an estimate of maintenance protein for a population of bluegill sunfish (Lepomis macrochirus) was calculated on a seasonal and yearly basis. (Sjolseth and Katz-Washington)
W70-07143

RELATIONSHIP OF RIVER POLLUTION TO BACTERIAL INFECTION IN SALMON (SALMO SALAR) AND SUCKERS (CATOSTOMUS COMMERSONI),
Fisheries Research Board of Canada, St. Andrews (New Brunswick).
John H. Pippy, and Gerard M. Hare.
Transactions of the American Fisheries Society, Vol. 98, No. 4, p 685-690, Oct 1969. 4 fig, 9 ref.

Descriptors: Atlantic salmon, Scukers, Catastomids, Pseudomonas, Aquatic bacteria, *Bacteria, *Fish diseases, Fishkill, *Mortality, Epizootiology, Water pollution effects, Heavy metals, *Copper, Water temperature, Fish behavior.
Identifiers: *Catostomus commersoni, *Aeromonas liquefaciens, *Epizootic, Miramichi River, New Brunswick, *Zinc.

During the summers of 1967 and 1968, the pseudomoned bacterium, Aeromonias liquefaciens, was involved in disease of Atlantic Salmon (Salmo salar) and suckers (Catostomus) in the Miramichi River, New Brunswick. The symptoms of this disease were ulcers and degenerated caudal, pelvic, and dorsel fins. A surge of copper and zinc pollution on late June 1967, and high river temperatures 22.5 deg C) enhanced production of an epizootic. The epizootic recurred during the summer of 1968. (Sjolseth and Katz-Washington)
W70-07144

EFFECTS OF pH OF CULTURE WATER ON THE GROWTH OF THE JAPANESE PEARL OYSTER (IN JAPANESE),
National Pearl Research Lab., Ago (Japan).
Yukimasa Kuwatani, and Nishii Tamotsu.
English summary. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 35, No. 4, p 342-350, 1969. 14 fig, 15 refs.

Descriptors: *Hydrogen ion concentration, Cultural control, Oysters, *Water quality, Water quality control, *Growth rates, Alkalinity, Ammonia, Nitrates, Mortality, Calcium, Phosphates.
Identifiers: Japanese Pearl oyster, *Pinctada fucata, *Culture water.

Thirty five one-year-old pearl oysters were equally divided into 7 groups, which were reared in separate recirculating tanks for 40 days. The pH of water of the experimental tanks was first adjusted to 6 different levels from 7.3 to 8.1 by adding necessary amounts of hydrochloric acid or sodium borate. Average pH values of culture water throughout the rearing period were 7.36, 7.48, 7.66, 7.78, 7.89 and 8.07 in the 6 experimental tanks and 8.04 in a control. The oysters in pH 8.07 and control tanks showed a rapid growth throughout the rearing period. Among the other oyster groups it was found that a decrease in oyster weight was directly related to pH. Most oysters reared in pH 7.36 and 7.48 died during the first half of rearing period. The relation between the weekly mean pH value and the daily weight increase differed with the stage of rearing. Oyster weight increases at pH, above 7.8 and decreases at lower pH during the first 19 days. After 20 days the relation is linear, being represented with the following expression: G (mg)= 29.589 pH-234.794. Where G and pH show the weekly mean of daily increase of oyster weight and pH after 20 days. The limiting pH for growth is estimated to be pH 7.935. It was concluded that the decrease in under-water weight of the oysters reared in low pH is mainly due to the dissolving of the shell rather than the decrease in the meat weight. (Sjolseth and Katz-Washington)
W70-07145

TOXICITY OF HYAMINE 3500 TO FISH,
Bureau of Sport Fisheries and Wildlife, Warm Springs, Ga. Southeastern Fish Control Lab.
James W. Hogan.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., 20402 - Price $0.35. In: Investigations in Fish Control, Rpt No. 32, 7 p, 1969. 8 tab, 7 ref.

Descriptors: *Bioassay, Mortality, *Toxicity, Hydrogen ion concentration, Lethal limit, Warmwater fish, Resistance, Bass.
Identifiers: *Hyamine 3500, *LC 50, Temperature effects, Goldfish, Effects of water quality.

Toxicity of Hyamine 3500 (a microbicide) to three species of trout and 11 species of warmwater fish was determined in static bioassays. Twenty-nine lots of fish from nine sources were used in water at various levels of pH, temperature, and total hardness. Hyamine 3500 is more toxic in alkaline or acidic water than in water with a pH of 7. In general, toxicity varies directly with temperature and inversely with total hardness. Dilute solutions of Hyamine 3500 appear to degrade rapidly in open vessels. (See also W70-07147 and W70-07148) (Sjolseth-Washington)
W70-07146

VOIDANCE TIME FOR 23 SPECIES OF FISH,
Bureau of Sport Fisheries and Wildlife, Warm Springs, Ga. Southeastern Fish Control Lab.
For primary bibliographic entry see Field 05A.
W70-07147

LABORATORY STUDIES ON POSSIBLE FISH-COLLECTING AIDS WITH SOME TOXICITIES FOR THE ISOMERS OF CRESOL,
Bureau of Sport Fisheries and Wildlife, LaCrosse, Wis. Fish Control Lab.
Robert M. Howland.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 - Price $0.35. In: Investigations in Fish Control, Report No. 34, 10 p, 1969. 17 refs, 3 tables, 2 figs.

Descriptors: *Bioassays, Laboratory experiment, Laboratory tests, Lethal limit, *Toxicity, Fishkill, *Fish physiology, *Fish control agents, Rainbow trout, Brown trout, Brook trout, Latic environment, Resistance.
Identifiers: LC 50, *Quinaldine, *McNeil-Jr-7464, *MS-222, *Cresol, *Fish collecting agents.

The relative merits of quinaldine McNeil-JR-7464, and three isomers of cresol (p-methylphenol, o-methlphenol, and m-methylphenol) as collecting agents were determined in a lotic system under laboratory conditions at 12 deg C. The toxicity of the three cresol isomers to rainbow trout, brown trout, and brook trout also was measured in bioassays conducted in standard constituted water, and LC50 values were calculated for exposures of 6, 24, 48, and 96 hours. The toxicity of para - cresol was also established for carp, fathead minnow, black bullhead, channel catfish, bluegill, and yellow perch. Conclusions of these toxicity and efficacy tests were as follows: (1) Para - cresol is the most active toxic of the three isomers of cresol; (2) The cresols are too harsh physiologically as fish-collecting agents; (3) MS-222 is not well suited as a fish-collecting tool; (4) Quinaldine may have some usefulness for collecting fish in small streams with rapid flow; (5) McNeil-JR-7464 does not induce surfacing but is effective at low concentrations and appears to have desirable characteristics as a fish-collecting agent. (See also W70-07147 and W70-07146) (Sjolseth-Washington)
W70-07148

5D. Waste Treatment Processes

BRACKISH WATER PURIFICATION BY BIOLOGICAL FUEL CELL POWERED ELECTRODIALYSIS,
Nebraska Univ., Lincoln.
For primary bibliographic entry see Field 03A.
W70-06755

IMPROVEMENTS IN TREATMENT DESIGN FOR ENHANCING WASTE WATER QUALITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
Dale A. Carlson, and H. Kirk Willard.
Washington University Water Research Center Final Project Report for FY 1968, July 11, 1968. 17p, 13 fig, 20 ref, append. OWRR Project No A-016-WASH.

Descriptors: *Tertiary treatment, *Aerobic treatment, Oxygen demand, Biochemical oxygen demand, Suspended load, Solids contact process, Sewage treatment, Trickling filters, Waste water treatment, Phosphates, Nitrates, Algae.
Identifiers: Solids removal.

A new two-phase biological tertiary waste treatment system includes an aerobic bacterial growth unit and a particulate removal unit. In the removal unit, the effects of suspended solids loading on a community of attached particulate feeding organisms were determined. A biomass yield of 16% of the influent suspended solids for the particulate feeders produced a low effluent solids concentration of only 0.069 mg suspended solids per mg B. O. D. removed. This dense material was found to settle rapidly. Total dissolved organic carbon was over 90% destroyed. Similar removal values of 90 to 94% were measured for B. O. D. The decreases of both organic carbon and B. O. D. were higher at lower loading rates. Most nitrogen compounds were oxidized to nitrates. As expected, the percent of nitrification decreased with increased loading. Phosphates were not removed except for the amount incorporated into wasted cell biomass ranging in magnitude from 22 to 36%. (Knapp-USGS)
W70-06792

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOL. IV. PROJECTED WASTE WATER TREATMENT COSTS IN THE ORGANIC CHEMICALS INDUSTRY.
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 06B.
W70-06841

ESTIMATING CONSTRUCTION COSTS OF WASTE WATER TREATMENT SYSTEMS,
Auburn Univ., Ala. School of Engineering.
James C. Farrow, Leo J. Hirth, and Joseph F. Judkins, Jr.
Textile Chemist and Colorist. Vol 2, No 3, p 35-40, February 11, 1970. 2 tab, 14 fig, 9 ref. OWRR Project A-008-ALA (3).

Descriptors: *Aeration, *Biochemical Oxygen Demand, *Costs, *Cost analysis, *Waste water treatments, *Textiles, Effluents, Waste treatment, Alabama, Georgia, Trickling filters, Activated sludge, Fibers (Plant).

A survey revealed that waste water from 30 textile plants in Alabama and West Georgia is discharged principally to city sewers with some prior treatment. Flowrates vary from 0.03 to 7.00 million gallons per day with BOD rates as high as 40,000 lbs a day. Using estimation methods for BOD based on cloth production and processing operations, construction costs (excluding land) are estimated for trickling filter, activated sludge and mechanically aerated treatment units. The costs are for waste water flowrates from 0.25 to 6.00 million gallons a day with BOD parameters of 300, 450 and 700 ppm. Mechanical aeration offers the lowest cost.
W70-06842

COMPUTER AIDED DESIGN OF WASTE COLLECTION AND TREATMENT SYSTEMS,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 06A.
W70-06849

SLUDGE DISPOSAL ALTERNATIVES--SOCIO-ECONOMIC CONSIDERATIONS,
Washington Univ., Seattle.
Brian W. Mar.
Journal of the Water Pollution Control Federation, Vol 41, No 4, April 1969, p 547-552, 2 fig, 11 ref.

Descriptors: *Costs, *Sludge disposal, Waste water treatment, Social aspects, Economics, Waste treatment, Ultimate disposal.
Identifiers: *Muddling process, Environmental control.

The necessity for socio-economic considerations in relation to sludge disposal are discussed. Results of analyses indicate that sludge disposal is not a major system consideration in a waste water management system unless only primary treatment is used. The amount of treatment for sludge prior to discharge should be decided on a socio-economic basis rather than technical considerations. The decision is made through a muddling process rather than through a logical basis, and most economic arguments do not consider shifts in social preferences nor total social costs. The costs of discharging the residue to the less sensitive element of the environment will be small compared to the total cost of maintaining the environment. Resources normally devoted to reducing the cost of sludge disposal should be directed toward reducing the cost of major element of environmental pollution. The alternative to this would be to collect the equivalent of the discharge treatment costs for the period prior to environmental damage and then use these funds to compensate those parties suffering damage and to provide treatment necessary to reduce damages to a socially acceptable level. In either situation, it is the socio-economic forces that will establish the criteria for sludge disposal. (Shankar-Texas)
W70-06862

IMPROVED SUBSURFACE DISPOSAL,
Public Health Service, Cincinnati, Ohio. Div. of Water Supply and Pollution Control.
Ronald A. Popkin, and Thomas W. Bendixen.
Journal Water Pollution Control Federation, Vol 40, No 8, p 1499-1514, Aug 1968. 15 fig, 5 tab, 10 ref.

Descriptors: *Waste water disposal, *Subsurface flow, *Water quality, Hydraulics, Chemical oxygen demand, Adsorption, Ultimate disposal, Filters, Groundwater, Tertiary treatment, Waste water treatment, Trickling filters, Effluents.
Identifiers: *Dosing rate, Primary effluent, Septic systems.

In the application of liquid waste to soil both continued hydraulic acceptance and quality of the percolate must be considered. Laboratory studies revealed that hydraulic acceptance as measured by the rate of wetted new surface area in a progressive ponding situation is influenced by the frequency of applying waste, the volume of waste applied, and the quality of waste applied. The rate of development of wetted absorption area decreases with decreased frequency of application and improved quality of waste applied. Within limits the efficiency of use of absorption area was improved with higher loading rates. That is, the rate of using cell did not increase as rapidly as the loading rate. The quality of the percolate improved with time after a relatively poor initial period. The results of these studies suggest that the design and operation of soil absorption system can be improved through use of once a week dosing and/or by use of improved pretreatment without imparing groundwater quality. (Hancuff-Texas)
W70-06863

PUBLIC ATTITUDES TOWARD USE OF RECLAIMED WASTE WATER,
California Univ., Berkeley.
William H. Bruvold, and Paul C. Ward.
Water and Sewage Works, Vol 117, No 4, p 120-122, April 1970. 2 tab, 2 ref.

Descriptors: *Water reuse, *Attitudes, *Reclaimed water, Surveys, California, Costs, Recreation facilities, Recreation, Social aspects.
Identifiers: *Public opinion.

A survey was made of two towns in California to determine the attitudes of the public concerning the uses of reclaimed waste water. Initial surveys yielded information about the public use in evaluation of reclamation projects which had been underway for some period of time. Additionally, attitudes toward a wide range of uses of reclaimed water were assessed in order to supplement the major data regarding existing reclamation projects. The results revealed that the facilities supplied with reclaimed water received moderate use by the households interviewed with recreational lakes receiving the highest degree of patronage, and that very few generally negative evaluations of water supplying these facilities were given. It should be emphasized that the questions employed to obtain the above information were administered before any reference was made to reclaimed waste water. A SECOND SET OF DATA IN CONTRAST TO THE PREVIOUS SURVEY WAS OBTAINED BY DIRECT REFERENCE TO POTENTIAL USES OF RECLAIMED WATER IN OR NEAR THE COMMUNITY BEING STUDIED. The results showed that the amount of expressed opposition to particular uses of reclaimed water is directly related to degree of contact and that expressed opposition drops off sharply after use of reclaimed water for swimming. (Hancuff-Texas)
W70-06864

BACTERIAL PHOTOSYNTHESIS IN THE OXIDATION PONDS OF AHMEDABAD, INDIA,
Central Public Health Engineering Research Inst., Ahmedabad (India). Field Centre.
Indira S. Jayangoudar.
Water and Sewage Works, Vol 115, No. 8, p 380-383, Aug 1968. 1 fig, 3 tab, 20 ref.

Descriptors: *Oxidation lagoons, *Photosynthetic bacteria, Biochemical Oxygen Demand, Dissolved oxygen, Hydrogen sulfide, Sewage treatment, Waste water treatment.
Identifiers: *Ahmedabad, India, Purple sulfur bacteria, Thiopedia rosea.

The phenomenon of bacterial photosynthesis, an anaerobic process, has been attributed to two selective groups of eubacteria. Thiorhodaceae, the purple colored sulfur bacteria, and Athiorhodaceae, the purple colored sulfurless bacteria, depend primarily upon light as an energy source and carry on a photosynthetic mode of metabolism. The origin, development, and ecology of Thiopedia rosea Winogradsky are discussed. On one occasion the bacterium was found to proliferate in the presence of a considerable amount of dissolved oxygen and on other occasions in the presence or absence of hydrogen sulfide. With the occurrence of Thiopedia rosea in the ponds, there was a considerable reduction in BOD ranging between 57.7% to 73.5%. Therefore, it would appear that the occurrence of purple colored sulfur bacteria in oxidation ponds does not affect their efficiency. Bacterial photosynthesis, occurring on the bottom layers of oxidation ponds, is believed to utilize solar radiation in the short infrared region of the spectrum. (Aguirre-Texas)
W70-06865

CATTLE, SWINE AND CHICKEN MANURE CHALLENGES WASTE DISPOSAL METHODS,
Connecticut Univ., Storrs.
R. Laak.
Water and Sewage Works, Vol 117, No 4, p 134-138, April 1970. 8 tab, 30 ref.

Descriptors: *Agriculture, *Cattle, Waste water Pollution), Costs, Nitrogen, Phosphorous, Potash, Fertilizers, Disposal, Pollution, Livestock, *Hogs, Poultry, Nitrogen compounds, Phosphorus compounds, *Farm wastes.
Identifiers: Chicken, Feedlots.

In the United States today approximately 0.66 billion lbs per day of manure must be extensively treated or destroyed. The trends in agriculture indicate that more livestock will be confined in the future, the concentration of the wastes increased, and the volume of manure per animal slowly reduced. Extensive data was collected and is presented giving the general characteristics of feces and urine of cattle, swine, and poultry as well as the quantitative consumption of feed, nitrogen, phosphorous, and potash. The manure characteristics are said to be changing and therefore the treatment process principles must also be changed. Costs and land requirements are given for manure disposal and an extensive outline enumerates the large variety of available disposal methods along with each one's particular drawback. The average cost of manure separation and final disposal must be a fraction of $3 to $40 per ton. (Hancuff-Texas)
W70-06866

GAS-LIQUID CHROMATOGRAPHIC TECHNIQUES FOR PETROCHEMICAL WASTE WATER,
Union Carbide Corp., South Charleston, W. Va.
For primary bibliographic entry see Field 05A.
W70-06867

A TOTAL SYSTEMS APPROACH TO POLLUTION CONTROL AT A PULP AND PAPER MILL,
Proctor and Gamble Co., Cincinnati, Ohio.
C. A. Barton, J. F. Byrd, R. C. Peterson, J. H. Walter, and T. H. Woodruff.
Journal of the Water Pollution Control Federation, Vol 40, No. 8, p 1471-1485, Aug 1968. 10 fig, 3 ref.

Descriptors: *Industrial wastes, *Waste water treatment, *Pulp wastes, Sewage treatment, Monitoring, Flotation, Evaporation, Aeration, Activated sludge.
Identifiers: *Paper making, Combustion.

A new pulp and paper mill on the Susuquehanna River at Mehoopamy, Pa. was designed with a 6 million dollar pollution control facility as an integral part. Spent liquors from the sulfite pulping process, high in oxygen demand, but low in suspended solids are concentrated and burned. The BOD's of the unconcentrated waste are from 30,000 mg/l to 40,000 mg/l. The more dilute pulping wastes are treated by activated sludge process. White water from paper making is screened, passed through an aeration flotation unit, and recirculated. Wastes from leaks and spills are treated by rotary screening. The emergency holding basins are provided to prevent untreated or inadequately treated discharges from reaching the river. The monitoring network samples the effluent, provides continuous analysis for pH, suspended solids, and total carbon, and checks river quality. (Hancuff-Texas)
W70-06868

COST OF CONVENTIONAL AND ADVANCED TREATMENT OF WASTE WATER,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
Robert Smith.
Journal of the Water Pollution Control Federation, Vol 40, No 9, p 1546-1574, Sept 1968. 31 fig, 9 tab, 23 ref.

Descriptors: *Costs, *Waste water treatment, Operation and Maintenance, Construction costs, Activated sludge, Trickling filter, Filtration, Activated carbon, Electrodialysis, Surveys, Chlorination, Pipelines, Ultimate disposal.
Identifiers: Primary treatment, Ammonia stripping, Microstraining, Aerator, Final Settling.

The cost associated with building and operating waste water treatment plants in individual waste water processes are presented. The information from several sources is brought together, using a consistent set of assumptions and ommissions, for a useful working document. The majority of the results are presented graphically with the cost in cents per thousand gallons plotted against design capacity in million of gallons per day. Most of the curves vary between 1 and 100 million gallons per day. Some of the costs presented include primary, activated sludge, and trickling filter plant capital, operation, and maintenance costs; coagulation and sedimentation costs; filtration, adsorption, DO, and chlorination costs; control house costs; and many others. (Hancuff-Texas)
W70-06869

PROFESSIONALISM AND WATER POLLUTION CONTROL IN GREATER CHICAGO,
Metropolitan Sanitary District of Greater Chicago, Ill.
Vinton W. Bacon, and Frank E. Dalton.
Journal of the Water Pollution Control Federation, Vol 40, No 9, p 1586-1600, Sept 1968. 15 fig, 1 tab.

Descriptors: *Sewage treatment, *Sewage disposal, *History, Financing, Sewers, Sludge disposal, Costs, Lagoons, Activated sludge, Underground storage, Water pollution, Waste water treatment, Professional personnel.
Identifiers: *Chicago, Combined sewers, Regional planning.

The Metropolitan Sanitary District of Greater Chicago formed in 1889, has successfully kept pollution out of the areas water supply and water recreation. The initial phase involved construction of canals to convey wastes over a low divide away from Lake Michigan to tributaries of the Mississippi River system. The need for lessening pollution in these channels led to construction of waste water treatment plants, the largest of which treats one billion gallons a day. Because of urban growth and higher water quality standards $713,000,000 worth of new facilities will be needed by the year 2000. These will include solids disposal by reclamation of marginal and strip mine land and underground storage system for combined sewer storm flows, tertiary treatment, and chlorination. Professionalism is needed to guide these developments and to make problems and recommended solutions understood by public officials. (Hancuff-Texas)
W70-06871

CONVERSION TO ACTIVATED SLUDGE AT UNION CARBIDE'S INSTITUTE PLANT,
Union Carbide Corp., South Charleston, W. Va.
G. W. Kumke, J. F. Hall, and R. W. Oeben.
Journal of the Water Pollution Control Federation, Vol 40, No 8, p 1408-1422, Aug 1968. 9 fig, 10 tab, 4 ref.

Descriptors: *Activated sludge, *Aeration, *Industrial wastes, Performance, Biochemical Oxygen Demand, Chemical oxygen demand, Sludge disposal, Instrumentation, Ponds, Sewage treatment, Stabilization, West Virginia, Waste water treatment, Biomass.
Identifiers: *Plant scale, Aerators, Institute (W Va).

To provide additional treatment of waste water for a petrochemical plant at Institute, West Virginia the existing aerated stabilization facility was converted to a completely mixed flocculant growth process. Selection of the process and equipment was based on the laboratory and pilot-scale studies. The addition consisted of doubling the surface aeration capacity to 2,000 hp adding two 70-ft-diameter peripheral feed clarifiers and providing biomass recycling equipment. The completed facility allows for an 80% increase in organic removal, from 50,000 lbs BOD per day to about 90,000 lbs BOD per day. Test work was undertaken to evaluate the change in biomass and operating conditions. Performance was monitored with conventional as well as total carbon chromatographic methods. The effects of aerator interaction on mixing and biomass diffusion was studied in the full scale basis. Hydraulic and specific organic effects on biomass separation were studied through dye dispersion and settleability tests. The applicability of various types of equipment including centrifuges, vibrating screens, hydraulic cyclones, and gravity thickeners to biomass dewatering also was investigated. (Hancuff-Texas)
W70-06872

THE SUGAR INDUSTRY IN PUERTO RICO AND ITS RELATION TO AN INDUSTRIAL WASTE PROBLEM,
Puerto Rico Univ., San Juan. School of Medicine.
Nelson Biaggi.
Journal of the Water Pollution Control Federation, Vol 40, No 8, p 1423-1433, Aug 1968. 3 fig, 6 tab, 2 ref.

Descriptors: *Industrial wastes, *Disposal, *Puerto Rico, *Sugarcane, Biochemical Oxygen Demand, Cooling water, Waste disposal, Water pollution.
Identifiers: Molasses, Filter cake, Sugars, Bagasse.

Although the sugar industry in Puerto Rico is declining it poses continuous waste problems. The wastes described are: cane fiber, filter cake, cooling, and condenser waters, and concentrated wastes from spillage, leaks, and washings. The cane fiber is usually disposed of through burning and in many cases supplies all the fuel required to supply the factory. The filter cake is the waste resulting from the clarification of the juices. It is suggested that the filter cake be used as a fertilizer rather than placed in a body of water. Cooling and condenser waters have a BOD of 100 mg/l due to entrainment of sugar. The suggested solution is the reduction of losses and re-circulation. The concentrated wastes though low in volume may have extremely high oxygen demands. It is suggested that the government give financial incentives for waste control particularly that accomplished by in-plant measures rather than treatment. (Hancuff-Texas)
W70-06873

JET AERATION IN ACTIVATED SLUDGE SYSTEMS,
Houdaille Industries, Inc., Prophetstown, Ill.; and Iowa Univ., Ames.
Richard W. West, and Wayne L. Paulson.
Journal of the Water Pollution Control Federation, Vol 41, No. 10, Oct. 1969, p 1726-1736. 8 fig, 1 tab, 11 ref.

Descriptors: *Activated sludge, *Aeration, *Costs, Efficiency, Mass transfer, Submergence, Waste water treatment, Sewage treatment.
Identifiers: *Jet aeration, *System design, Aerator submergence, Waste treatment basin, Piping distribution.

A jet aerator development program and system design study that extends the original work from particular operating conditions to the full spectrum of fluid flow, submergence, and system design is described. Jet aerator performance was analyzed under standard test conditions and the oxygen absorption values per unit of power input were found to be in range similar to other types of aeration devices. It was shown that with optimum liquid flow rate, aeration efficiency improved with decreasing air flow rates. Jet aerator systems provide complete mixing of aeration basin contents and can easily be adopted to automated control of air flow rates for optimum system performance. Guidelines are recommended for selection of aeration system components. A typical layout is presented to illustrate system design for optimum performance in activated sludge waste-water treatment units. (Shankar-Texas)
W70-06874

CASE HISTORY OF WASTE WATER TREATMENT ON A GENERAL ELECTRIC APPLIANCE PLANT,
General Electric Co., Schenectady, N.Y.
J. S. Anderson, and E. H. Iobst, Jr.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1786-1795, Oct 1968. 12 fig, 9 tab, 4 ref.

Descriptors: *Industrial wastes, *Waste water treatment, History, Costs, Operations, Aluminum, Metals.
Identifiers: General Electric, Allantown (Pa), Nickel, Caustic wastes, Solids.

Waste water discharges from a small appliance plant are treated to remove metal ions, acids, and alkali. The current average flow is 230 million gallons per year. The initial equipment installed and the manner in which the treatment system had been expanded to keep pace with expanding manufacturing operations are discussed. Specifically covered are: (1) description of the sources of waste waters generated, (2) volumes of waste water, (3) analysis of waste streams, (4) treatment plant performance, (5) costs, amounts, and frequency of use, (6) labor, maintenance, and utility expenses, and (7) annual fixed costs of operation. (Hancuff-Texas)
W70-06876

FREEZING METHODS USED TO CONDITION ACTIVATED SLUDGE,
Rex Chainbelt Inc., Milwaukee, Wis.
William J. Katz, and Donald G. Mason.
Water and Sewage Works, Vol 117, No 4, p 110-114, April 1970. 9 fig, 13 ref.

Descriptors: *Sludge treatment, *Filtration, *Freeze-thaw test, Pilot plants, Freezing, Activated sludge, Dissolved solids, Suspended solids.
Identifiers: *Conditioning, Loading, Filter cake, Wire screen cloth.

During the last few years a renewed attention has been placed on physical methods of sludge conditioning in an attempt to eliminate the need for chemical conditioners. The freezing of activated sludge causes the suspended solids to agglomerate and form relatively large floc particles. Upon thawing these floc particles separate rapidly leaving a clear supernatant and occupy significantly less volume than before freezing. A pilot scale study was made to determine the effectiveness of freezing as a conditioner of activated sludge. The sludge concentrations used during the study ranged from 1 to 2.5%. After freezing the sludge was thawed and gravity filtered by various size wire screens, 140-24 mesh placed in a 9 cm buchner funnel. The screens had an effective area of 0.0575 sq ft. Results of this study showed that a solid production rate of 36 to 57 lbs of dry solids per sq ft per hour was attainable. This figure is 10 to 20 times higher than that which would be expected from vacuum filtration of the same sludge. The filtrate quality obtained was less than 250 mg/l of suspended solids. This compares with a vacuum filter filtrate of 500 mg/l to 10,000 mg/l. Despite the encouraging results obtained by freezing conditioning methods development of the process was limited for the following reasons: (1) high cost and consumption of power, (2) high capital and operating costs and (3) frequent washing of filter media. (Hancuff-Texas)
W70-06877

EVALUATION OF THE JERIS RAPID COD TEST,
San Antonio, Tex.
W. N. Wells.
Water and Sewage Works, Vol 117, No 4, p 123-129, April 1970. 12 fig, 8 tab, 5 ref.

Descriptors: *Chemical Oxygen Demand, *Evaluation, *Biochemical Oxygen Demand, Temperature, Waste water treatment.
Identifiers: *Jeris-Chemical oxygen demand, Total organic carbon, Standard methods, Glucose, Glutanic acid.

The rapid COD test developed by Jeris (Water and Wastes Engineering 4:89, 1967) has not received wide attention and acceptance. The small amount of special equipment required, the speed with which the test results are obtained, and the precision of the results are remarkable. The rapid COD tests consists of oxidizing the sample by heating in the presence of a mixture of strong acids, potassium dichromate, and a catalyst to a definite temperature 165 deg C and then titrating the excess dichromate with standard ferrous ammonium sulfate using ferroin as an indicator. Extensive investigations were made on the effects of sample volume, temperature, digestion time, dilution, and heat destruction of dichromate. A battery of tests were also made correlating the BOD5 and the rapid COD test for both raw waste water and effluent from secondary treatment. The results showed a fairly close correlation between COD and BOD values. When testing a glucose glutamic mixture the variation of COD values were within the standard deviations suggested by Standard Methods for the BOD analysis. (Hancuff-Texas)
W70-06878

SOLIDS RETENTION IN ANAEROBIC WASTE WATER TREATMENT SYSTEMS,
Kansas Univ., Lawrence. Environmental Health Engineering Lab.
R. Dague, R. E. McKinney, and J. T. Pfeffer.
Journal of the Water Pollution Control Federation, Vol 42, No 2, p R29-R43, February 1970. 6 fig, 6 tab, 29 ref.

Descriptors: *Anaerobic digestion, *Performance, Chemical precipitation, *Anaerobic bacteria, *Flocculation, Waste water treatment, Sludge, Chemical Oxygen Demand, Hydrogen ion concentration.
Identifiers: *Solids retention time, *Ferrous chloride, Topeka (Kan).

The results from a laboratory investigation of the biological solids retention time aspects of anaerobic waste treatment are presented. The minimum solids retention time for the domestic waste water sludge substrate utilized and a temperature of 35 deg C was found to be 30 days. A solids retention time of 10 days or more was required to prevent wash-out of key organisms and a resulting rapid decrease in process efficiency. Anaerobic biological solids can be flocculated in a manner similar to aerobic sludges, but excessive turbulence can destroy flocculation. An intermittent mixing study showed that intermittent mixing significantly improved the biological flocculation and solids separation resulting in a significant decrease in the effluent volatile solids concentration. Chemical coagulation can be used to aid separation of anaerobic biological solids. Chemical coagulation of the effluent and return of the precipitated sludge was carried out by raising the pH of the effluent to 8.3 with sodium by dioxide followed by the addition of sufficient ferrous chloride ($FeCl2.H2O$) to form a readily-settleable floc. COD removal efficiencies averaged 96.3 percent. Viable methane organisms can be returned to the system by this method of chemical coagulation. (Galwardi-Texas)
W70-06879

THE ANAEROBIC FILTER FOR WASTE TREATMENT,
Stanford Univ., Calif. Dept. of Civil Engineering.
J. C. Young, and P. L. McCarty.
Journal of the Water Pollution Control Federation, Vol 41, No 5, Part 2, p R160-R173, May 1969. 7 fig, 5 tab, 9 ref.

Descriptors: *Anaerobic digestion, *Performance, *Filtration, *Pilot plants, Chemical Oxygen Demand (COD), Sludge, Waste treatment.
Identifiers: *Anaerobic filter, *Loading rates, Solids production.

Effective treatment of low strength soluble organic wastes was accomplished using an anaerobic filter. Long biological solids retention times, efficient operation at 25 deg C, low solids production, low head losses and the lack of requirements for mixing, heating and recirculation were some of the advantages presented for the anaerobic filter process. Six-feet-tall, six-inches-diameter columns filled with quartzite stone were used to treat protein and protein carbohydrate waters at loadings of 26.5 to 212 lb chemical oxygen demand/day/1000 cu.ft. Detention times varied from 4.5 to 72 hrs. Start-up results showed the merit of using a heavy bottom seed as compared to a light uniform seed. Results from tests on loading rate variations on a given filter showed that a loading rate of 26.5 lb COD/day/1000 cu ft, 93% COD removal was obtained while at a loading rate of 212 lb COD/day/1000 cu ft only 60% COD removal was obtained. It was noted that treatment efficiency did not improve greatly with heights greater than 4 feet. (Galwardi-Texas)
W70-06880

SOME SEWAGE PROBLEMS IN EUROPE TODAY,
Instituut voor Gezondheidstechniek TNO, Delft (Netherlands). Div. of Water and Soil Research.
J. K. Baars.
Water Pollution Control, Vol 68, No 5, p 529-534, 1969. 5 tab, 12 ref.

Descriptors: *Eutrophication, *Nitrogen, *Phosphorus, *Detergents, *Phenols, Waste treatment, Waste disposal, Waste water (Pollution), Water Quality, Costs, Capital costs, Waste water treatment.
Identifiers: Population equivalents, Oxidation ditch.

Several European waste water treatment problems including eutrophication, nitrogen and phosphorus removal, detergents, insecticides, and phenols are discussed. The facilities, capital and operating costs of several European treatment plants are also discussed. Some 10,000 metric tons of phenols or about two-thirds of the phenols released by the coking plants in the Emscher and Lippe River basins are intercepted and treated yearly in 25 dephenolating plants. The 'inhabitant equivalent,' widely defined as equal to 54 g BOD/day, is not regarded as reliable for design. Instead, the actual loading should be used for design. Several European countries have outlawed the use of 'hard' detergents due to their residual effects in water. Surface active substances have been found to influence the oxygen exchange coefficient in water. Undesirable algae growths occur when the phosphorus concentration exceeds 0.1 mg/l and the nitrogen concentration exceeds 0.3 mg/l. The average daily human excretions contain 0.7-3.7 g of P, of which 50-60% is in the urine. Modern detergents contain 37-48% phosphates on a dry basis. Experimentation is in progress to replace phosphates by nitrilo triacetate. Phosphorus can be effectively removed by chemical precipitation. Using lime $Ca(OH)2$ as a coagulant, 93.4% P removal was obtained at a dosage of 1.5 times the carbonate hardness as $CaCO3$. International cooperation on a river basin or regional scope is needed to curb pollution in Europe. (Makela-Texas)
W70-06881

HIGH QUALITY REUSE WATER BY CHEMICAL-PHYSICAL WASTE WATER TREATMENT,
New York Univ., Bronx.
Matthew M. Zuckerman, and Alan H. Molof.
Journal of the Water Pollution Control Federation, Vol. 42, No. 3, p 437-456, March 1970. 14 fig, 5 tab, 25 ref.

Descriptors: *Hydrolysis, *Activated carbon, *Waste water treatment, Water reuse, Hydrogen ion concentration, Activated sludge, Chemical oxygen demand, Costs, Biological treatment.
Identifiers: *Chemical-physical treatment, *Colloidal organics, Soluble organics, Molecular weight distribution.

With the increasing demand for high quality water or reuse, an effort is made to maximize the effectiveness of activated carbon adsorption. Increasing he pH to a value of 11.5 is reported to cause hemical hydrolysis. This hydrolysis pre-treatment efore activated carbon adsorption results in a etter quality water for raw waste water than for ctivated sludge effluent when both are subjected o the same pre-adsorption chemical hydrolysis. he conventional tertiary treatment which includes ctivated sludge treatment was found to be inferior, oth qualitatively and economically to the chemial pre-treatment followed by activated carbon reatment. (Hancuff-Texas)
W70-06882

NITROGEN REDUCTION BY SYSTEM ALTERATION,
Toronto Univ. (Ontario).
A. L. Atkinson.
Water and Pollution Control, Vol 69, No 2, p 20-21, February 1970. 2 fig.

Descriptors: *Sewage treatment, *Nitrogen, Activated sludge, Nutrients, Sludge disposal, Waste water treatment, Waste treatment, Nitrification, Denitrification.
Identifiers: *Process modification, Ash Bridge Bay, Toronto.

A study was conducted in 1968 at the main sewage treatment plant in Ash Bridge Bay, Toronto to determine what process modifications could be made to limit the nitrogen effluent from the existing plants. The treatment plant consists of a conventional activated sludge plant complete with two stage digestion, vacuum filtration and inceneration. Waste streams of activated sludge, digester overflow, spent elutriating water and filtrate are recycled to the primary settling tanks. Samples of the above waste streams were collected and analyzed for all forms of nitrogen. A nitrogen balance for each unit process was calculated. The recycled liquors while amounting to only 4% of the raw sewage flow contained 56% of the raw sewage nitrogen. Laboratory tests on a combination of the four recycled streams showed that sedimentation could produce a sludge of 3% consistency which contained 75% of the nitrogen. This sludge could be vacuumed filtered along with digested sludge and the nitrogen would be permanently removed. (Hancuff-Texas)
W70-06883

DRYING OF SAND-DIGESTED SLUDGE MIXTURES,
Washington Univ., Seattle. Dept. of Civil Engineering.
M. E. Harper, and B. W. Mar.
Journal of the Sanitary Engineering Division, Proceedings of the ASCE, Vol 96, No SA2, p 381-393, April 1970. 8 fig, 5 tab, 10 ref.

Descriptors: *Sludge disposal, *Sludge digestion, *Drying, Sewage sludge, Sewage treatment, Design, Sands, Centrifugation, Waste treatment.
Identifiers: *Falling-rate period, Design equation.

An empirical design equation was developed to estimate the drying rate during the falling-rate drying period of a mixture of sand and centrifuged digested primary domestic sewage sludge to be used as a fill material. The average moisture content calculated from the drying rate was required in order to facilitate placement of the fill in the field at maximum density. Data were collected over a nine-month period to develop the design equation. Three different sands with sand to sludge dry solids ratios ranging from 0:1 to 30:1 were used. The primary variables considered were sand to sludge dry weight ratio, ambient temperature, and ambient relative humidity. The mean error found between the experimental and predicted drying rates from the design equation was 35% with a standard deviation of error equal to 25%. The failure to include air velocity in the design equation and the source of weather data were postulated as being the major cause for this error. Mixture depth and sand particle size were not found to affect drying rates for the ranges and distributions tested. The design equation was not verified for polymer treated sludges. (Galwardi-Texas)
W70-06884

COMPARISON OF VARIOUS NITROGEN SOURCES IN ANAEROBIC TREATMENT,
Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.
R. Gasser, and J. S. Jeris.
Journal of the Water Pollution Control Federation, Vol 41, No 2, Part 2, p R91-R100, February 1969. 4 fig, 7 tab, 5 ref.

Descriptors: *Anaerobic digestion, *Nutrient requirements, *Nitrogen compounds, Laboratory tests, Industrial wastes, Chemical Oxygen Demand (COD), Waste treatment, Sewage treatment.
Identifiers: *Ammonium chloride, *Sodium nitrate, *Ammonium nitrate.

The effects of various nitrogen nutrients on the anaerobic treatment of a nitrogen-deficient industrial waste were investigated. Batch laboratory-scale digesters operated at 35 deg C and a detention time of 12 days were fed a mixture having a COD of 7400 mg/l which was 89 percent cornstarch and 11 percent corn syrup. Both mixed and unmixed conditions were investigated in each instance. NH4Cl, NaNO3 and NH4NO3 in concentrations ranging from 2.8 to 156.8 mg/l were used as nitrogen sources. Results of the unmixed systems showed that about 80% COD removal was obtained using the higher concentrations of nitrogen, while only 67% removal was obtained at the lower nitrogen concentrations. Results of the mixed systems showed that about 74, 43 and 60 percent COD removal was obtained using the higher concentrations of NH4Cl, NaNO3 and NH4NO3 respectively. COD removal of 71, 19 and 21 percent were obtained using the lower concentrations of these nitrogen sources. NH4Cl, at both concentrations utilized, proved to be the most efficient source of nitrogen during the mixed phase. It was noted that less nitrogen was used for satisfactory treatment of the unmixed systems than for the mixed systems. (Galwardi-Texas)
W70-06885

U-TUBE AERATION OPERATING CHARACTERISTICS,
New Mexico State Univ., Las Cruces.
Richard E. Speece, Jack L. Adams, and Carolyn B. Wooldridge.
Journal of the Sanitary Engineering Division, ASCE, Vol 95, No SA3, p 563-574, June 1969. 12 fig, 1 tab, 1 ref. OWRR Project A-011-NMEX.

Descriptors: *Aeration, *Head loss, *Dissolved oxygen, Velocity, Dimensional analysis, Pilot plants, Waste water treatment, Reservoirs, Fish hatcheries.
Identifiers: *U-Tube aeration, Depth of submergence, Air-water ratio.

A modification of U-tube aeration, which injected air into the system with an air disperser instead of drawing air into the system by a flow constriction, was studied on a pilot scale. Advantages of the modification include more operational flexibility and less hydraulic head loss. Four-inch-diameter pipe was used as the pilot aerator and depths of 10, 20, 30 and 40 feet were studied at water flow rates of .22 to .73 fps, air water ratios of 0 to 26 percent, and disperser submergence of 1 to 35 feet. Variables measured included head loss due to air injection (delta H) and change in dissolved oxygen (delta DO). Increasing the percentage of air to water increased delta DO at a diminishing rate. Increased depth of aerator submergence reduced delta DO and delta H for a given air water ratio. Higher velocities resulted in a slight reduction of delta H and delta DO. For other variables constant, both delta H and delta DO were found to be a function of U-tube depth. The U-tubes system favors deeper depths, larger installations and higher velocities to minimize overall transfer costs. Dimensional analysis was performed. (DiFilippo-Texas)
W70-06886

BIOCHEMICAL DECOMPOSITION OF THE HERBICIDE N- (3,4-DICHLOROPHENYL)-2-METHYLPENTANAMIDE AND RELATED COMPOUNDS,
Rutgers - The State Univ., New Brunswick, N.J.
Nagim El-Din Sharabi, and Lucien M. Bordeleau.
Applied Microbiology, Vol. 18, No. 3, p 369-375, September 1969. 4 fig, 2 tab, 12 ref.

Descriptors: *Herbicides, *Biodegradation, *Hydrolysis, Isolation, Fungi, Enzymes, Degradation (Decomposition), Kinetics.
Identifiers: *Karsil, *Organisms.

A group of organisms were isolated, identified and tested for their ability to hydrolyze N- (3,4-Dichlorophenyl)-2-Methylpentanamide (Karsil). The rate of decomposition by 3 fungi with the herbicide as the sole carbon source is presented. The measurements are based on the accumulation of the product 3, 4, dichloroaniline (DCA). The enzyme Karsil Acylamibase was induced in a partially purified stage and tested for its ability to hydrolyze 25 related compounds. Some relations between structures of these compounds and their susceptibility to enzymatic hydrolysis were discerned. (Hancuff-Texas)
W70-06887

THEORETICAL CONCEPT OF GRAVITY SLUDGE THICKENING SCALING-UP LABORATORY UNITS TO PROTOTYPE DESIGN,
Texas Univ., Austin.
Howard J. Edde, and W. Wesley Eckenfelder Jr.
Journal of the Water Pollution Control Federation, Vol 40, No 8, p 1486-1498, Aug 1968. 11 fig, 2 tab, 28 ref.

Descriptors: *Sludge, *Mathematical model, *Design, Models, Sewage treatment, Sludge disposal, Waste water treatment.
Identifiers: *Thickeners, Solids.

Principle parameters involved in batch and continuous thickening operations and the use of these parameters to develop a mathematical model for the design of continuous thickening units were established. Five types of sludges were investigated. Significant parameters studied were feed, and underflow solids, concentrations, settling column heights, mass loading, rheological properties of the sludge, solids detention time, and sludge blanket depth. The results showed that both batch and continuous systems can be described by the mathematical model designed by the relationship Cu/Co-1=D/ (ML)N. The parameters Cu and Co are underflow and feed concentrations, while ML is the mass loading in psf/day lb solids/day/sq ft. The exponent n, describes the rheological properties of the sludge and is a constant for a specific sludge. The constant D is used to correlate batch and continuous systems and depends on feed concentration, detention time, and sludge blanket depth. This model provides a rational method for design of continuous thickeners from laboratory data. (Hancuff-Texas)
W70-06888

A CHEMICAL-PHYSICAL WASTE WATER RENOVATION PROCESS FOR KRAFT PULP AND PAPER WASTES,
Louisiana State Univ., Baton Rouge.
Donald R. Smith, and Herbert F. Berger.
Journal of the Water Pollution Control Federation, Vol 40, No 9, p 1575-1581, Sept 1968. 4 fig, 2 tab, 18 ref.

Descriptors: *Industrial wastes, *Water reuse, Waste water treatment, Biochemical Oxygen De-

mand, Color, Dissolved solids, Biological treatment, Activated carbon, Costs, Demineralization, Lime, *Pulp and paper industry.
Identifiers: *Chemical-physical treatment, *Kraft pulp.

The nature of pulp and paper wastes make it difficult to obtain the necessary reduction of BOD, color, and dissolved solids with a single treatment process. Proposed is an overall treatment scheme which handles the waste water step wise to produce a reusable process water. A four stage process utilizing lime dosing, biological treatment, activated carbon filtration, and demineralization was used on bleached and unbleached craft, total mill effluent. A three stage system without biological treatment also was tested. Biochemical oxygen demand (BOD) and color removal were 97% and 99.5%, respectively, for four stage; and 85.5% and 99.5%, respectively, for three stage. Cost comparisons are made. The four stage processed reusable water would cost approximately 4.5 cents/1000 gallons, and the three stage process would cost approximately 10 cents/1000 gallons. (Hancuff-Texas)
W70-06889

DATA PROCESSING IN PHILADELPHIA,
Philadelphia Water Dept., Pa.
Carmen F. Guarino, and Jospeh V. Radziul.
Journal of the Water Pollution Control Federation, Vol 40, No 8, p 1385-1396, August 1968. 11 fig.

Descriptors: *Waste water treatment, *Data processing, *Computers, Activated sludge, Logging, Operations, Monitoring.
Identifiers: *Programming, Reports, Fortran II, Fortran IV, Philadelphia.

Efficient operation of Northeast high aeration plant in Philadelphia, Pa. requires the monthly tabulation of 12,000 operational entries comprising a monthly and annual report. To minimize the time required to prepare such reports, and to keep the plant operation up to date, a General Electric Data logging program using the Philadelphia Water Departments 1620 IBM computer in Fortran II language was prepared. The program includes statistical analysis, warnings, and daily, weekly, monthly, and yearly outputs. The current run time of 6.75 hours is expected to be cut to 1.5 hours with the use of Fortran IV and the IBM 1130. The programming will be expanded to include two similar Philadelphia plants with flows of 136 million gallons per day each. (Hancuff-Texas)
W70-06890

SLUDGE HANDLING,
Potter (Alexander) Association, New York.
Anton E. Sparr.
Journal of the Water Pollution Control Federation, Vol 40, No 8, p 1434-1442, Aug 1968. 6 fig, 2 ref.

Descriptors: *Sludge disposal, *Sludge digestion, Settling basins, Chemical treatment, Dewatering, Incineration, Waste water treatment, Sludge.
Identifiers: *Sludge handling, *Operator, Drying beds, Sea disposal.

Evaluation of sludge handling techniques is given from an operational standpoint. The problems are discussed with sedimentation tanks, digesters, drying beds, sea disposal, and chemical treatment. Mechanical dewatering devices which are discussed include vacuum filters, filter presses, centrifuges, and gravitational devices. Incinerators are also discussed. The processes of wet-air oxidation, multiple hearth furnace burning fluidized bed incineration and cyclone incinerations are included. Methods and problems are discussed in detail. (Hancuff-Texas)
W70-06891

HYDROGEN SULFIDE DAMAGE TO CONCRETE PIPE,
Seattle Metropolitan Municipality, Wash.
James E. Hawthorn.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 425-430, March 1970. 11 fig.

Descriptors: *Hydrogen sulfide, *Concrete pipes, *Corrosion, Pipelines, Sewers, Operation and maintenance, Odor, Pipes, Conveyance structures.
Identifiers: *Waste water collection system, Wet well, Wash main, Interception lines, TV camera, Sulfuric acid.

Experiences of the municipality of metropolitan Seattle in hydrogen sulfide corrosion of the waste water system are cited. The greatest potential for concrete damage due to hydrogen sulfide exists at the discharge point of a waste water force main. Therefore, a long force main was used in the study. In the absence of free oxygen, sulfides are produced in waste water by the action of anaerobic bacteria on sulfate. The resulting hydrogen sulfide is highly soluble in water and is retained in solution until the waste water is released to atmospheric conditions. A concrete gravity line at the end of the force main being studied was inspected through the use of a television. The results showed the crown to be severely corroded and the corrosion seemed to lessen with the distance downstream. Chlorination of the most upstream wet well suppressed the hydrogen sulfide generation to a degree that no visible sign of concrete deterioration was evident. (Hancuff-Texas)
W70-06893

THE USE OF FLY ASH IN CONDITIONING BIOLOGICAL SLUDGES FOR VACUUM FILTRATION,
Notre Dame Univ., Ind.
Mark W. Tenney, and Gerald T. Cole.
Journal of the Water Pollution Control Federation, Vol 40, No 8, Part 2, p R281-R302, August 1968. 11 fig, 3 tab, 3 ref.

Descriptors: *Fly ash, *Sludge treatment, *Filters, Disposal, Dewatering, Hydrogen ion concentration, Activated sludge, Incineration, Organics, Laboratory tests, Phosphorus, Waste water treatment.
Identifiers: *Vacuum filtration, *Biological sludge, Flocculation, Sludge conditioning.

Buchner funnel tests were used to determine the effectiveness of fly ash as a conditioner of waste activated and digested sludges prior to vacuum filtration. The study revealed that the most desirable fly ash for dewatering of biological sludges is one with a high carbon content and a particle size in the range of 10 - 30 microns. A dosage of 50 grams per liter was shown to be optimum for all phases of the process including dewatering, fuel value, filtrate quality, etc. Results of experimental data on activated sludge dewatering showed that this dosage results in: (a) dewatering near optimum, (b) percent moisture content of cake almost reduced to its minimum value, (c) cake value with the highest fuel value and (d) complete phosphate removal. The values for these removals are 50% organic removal, 95% residual soluble orthophate removal, reduction from 84% to 63% moisture content. (Hancuff-Texas)
W70-06894

MEASUREMENT OF FILM ACCUMULATION IN A TRICKLING FILTER BY NEUTRON MODERATION,
North Carolina State Univ., Raleigh.
Jess A. Sullins, Jr., and William S. Galler.
Journal of the Water Pollution Control Federation, Vol 40, No 8, Part 2, p R303-R315, August 1968. 14 fig, 4 tab, 11 ref.

Descriptrs: *Films, *Trickling filter, *Measurement, Biochemical oxygen demand, Waste water treatment, Filter, Biological treatment, Performance, Distribution, Efficiencies, Microorganisms, Sewage treatment.
Identifiers: *Neutron moderation, *Accumulation.

High energy or fast neutrons emitted from the nucleus of heavy atoms can be slowed down or moderated by inelastic scattering and elastic scat tering. Good moderators must be light in order to absorb larger amounts of energy per collision. The slimes formed in biological filters contain large amounts of water as well as carbon, nitrogen, and oxygen, which are all good moderators. Method and instrument calibration are presented. The study conducted on a trickling filter at Raleigh North Carolina showed that the amount of film present during the summer months is 50% less than that during the winter. The film was evenly distributed over the depth during the summer but substantially larger film accumulated at the filter top during the winter. There was no correlation found between filter performance and weight of slime accumulation. A typical biomass distribution for a winter day showed for a depth of 1.5 feet 30 grams per cubic foot, and for a depth of 4.5 feet 235 grams per cubic foot. A typical summer day showed a biomass distribution of 115 grams per cubic foot throughout the depth. (Hancuff-Texas)
W70-06895

AN IMPROVED TOOL FOR MEASURING BIODEGRADABILITY,
Washington Univ., St. Louis, Mo.
R. H. F. Young, D. W. Ryckman, and J. C. Buzzell, Jr.
Journal of the Water Pollution Control Federation Vol 40, No 8, Part 2, p R354-R368, August 1968. fig, 4 tab, 16 ref.

Descriptors: *Biodegradation, *Organics *Biochemical oxygen demand, *Carbon, Laboratory test, Chemical oxygen demand, Nitrification, Chemical degradation, Measurement, Oxidation, Respiration.
Identifiers: *Total organic carbon, Growth.

The system was designed to provide the rate degree of biodegradation and the influence of organic compounds on aquatic life. The technique involved measurement of microbial respiration determined by oxygen utilization, chemical oxyge demand, total organic carbon, measurement bacterial growth and bioassays of unit effluent. The recommended period of study is 20 days and the chemical concentration is 10 mg/l. To test the general applicability of the method, twenty organi chemicals were studied, varying in structure, composition, biochemical behavior and toxicity. good indicator of the fate of organic carbo removed from solution during biodegradation wa the ratio of respiratory carbon to synthesis carbon The onset of nitrification in the system can b identified rapidly by use of the colorimetric metho measurement of nitrite. This measurement helps t differentiate between the carbonaceous and th nitrogenous oxygen demand. (Hancuff-Texas)
W70-06896

AERATION SWEETENS HARBOR BASIN I LOS ANGELES,
Pomeroy, Johnston and Bailey, Pasadena, Calif.
Henry Cruse.
Water and Pollution Control, Vol 108, No 4, p 4 44, April 1970. 1 fig.

Descriptors: *Aeration, *Waste water disposa *Industrial waste, *Dissolved oxygen, Waste trea ment, Performance, Biochemical Oxygen Deman Costs.
Identifiers: *Los Angeles harbor, *Vegetable products.

A vegetable oil refinery is discharging about 10,00 pounds of BOD per day to slip number 5 in the L Angeles harbor. This, along with an estimate 14,000 pounds of BOD per tidal change caused pollution problem. In 1968 a wider program water quality control was enforced and it w necessary to provide treatment. The cost of on-si BOD treatment was prohibitive, on the order of quarter of a million dollars, and forced main pum ing to the nearest treatment plant would co $420,000 for construction and $40,000 annuall Finally it was decided to treat the entire body

olluted water. The avoidance of navigational roblems eliminated the use of a surface aerator nd a novel air diffuser had to be used. The air dif- user is anchored to the bottom of the body of ater and is held erect by the vertical flow of air. When the air flow is shut off the diffuser will sink to he bottom and thus allow ships to pass over. Not he least of the considerations was the estimated ost of $130,000 capital cost, and $20,000 annual ost, very much lower than the other methods con- idered. Slip number 5 showed an unequivocal and narked improvement. This achievement was found o be due to two different effects exerted by the ystem. First, it acted as a mixing device increasing he dilution factor ten fold, and second, it increased upply of dissolved oxygen in the order of 1 lb ox- gen per horsepower hour. (Hancuff-Texas)
W70-06897

CHEMICAL PRECIPITATION OF PHOSPHORUS IN A HIGH-RATE ACTIVATED SLUDGE SYSTEM,
Pennsylvania State Univ., University Park.
William A. Eberhardt, and John B. Nesbitt.
Journal of the Water Pollution Control Federation, Vol 40, No 7, p 1239-1269, July 1968. 13 fig, 20 ab, 47 ref.

Descriptors: *Activated sludge, *Phosphorus, *Chemical precipitation, Domestic wastes, Waste water treatment, Sewage treatment, Biochemical Oxygen Demand, Efficiency, Performance.

A biological-chemical process utilizing high-rate ctivated sludge system offers high BOD removals s well as high phosphorus removals. In a laborato- y scale pilot study, both synthetic and domestic waste water were used under completely mixed conditions. A 60 liter per day waste was treated with an aeration time of 2.7 hours including the air- gitated chemical mixing basin. Solids that were eparated in a clarifier were returned to the aera- ion basin and excess sludge was wasted semicon- tinuously. Aluminum sulfate was added to the mixed liquor to precipitate the phosphorus. The precipitate is settled, returned and wasted with the sludge. The system produced effluent residuals of ess than 2 Mg PO4/l unfiltered, and 0.05 mg PO4/l iltered total phosphate and 20 mg/l BOD5. In- fluent measurements were 39.1 mg phosphorus/l, 260 mg BOD5/l, and loading of 146 lb BOD/d/1000 cu.ft. Aluminum sulphate dosage requirement for this result was 335 mg/l. (Hancuff-Texas)
W70-06898

FUNCTION OF SOLIDS IN ANAEROBIC LAGOON TREATMENT OF WASTE WATER,
Melbourne Water Science Inst. (Australia).
C. D. Parker, and G. P. Skerry.
Journal of the Water Pollution Control Federation, Vol 40, No 2, p 192-204, February, 1968. 13 tab, 4 ref.

Descriptors: *Anaerobic conditions, *Effliciencies, *Lagoons, *Sludge, Algae, Biochemical Oxygen Demand, Mixing, Sewage treatment, Waste water treatment.
Identifiers: *Anaerobic treatment, *Australia, Laboratory-scale studies, Plant-scale studies, Removal.

Field studies of anaerobic lagoons in Australia have shown that solids farther from the inlet of a lagoon are more active in purification than those deposited closer to the inlet, although in many cases they show lower gas yields. Lagoon sludge purification index (Lbs BOD/acre/day/lb VS) values ranged from 0.0053 during the winter at a typical pond inlet to 0.00902 during the summer at the pond outlet. The organic load to the pond during this period was about 482 lbs BOD/day/acre, and the sludge gas yield varied from 1.2 to 7.7 ml/day/gVS. The presence of algae in pond supernatant apparently does not reduce the sludge's BOD removal capacity. Where methane fermentation is inhibited, BOD can still be removed by sulfate reduction. Laboratory studies showed that a substantial increase (almost 30%) in BOD removal can be achieved by mixing sludge with the supernatant, and that algae proliferate readily in media with high organic contents. (Aguirre-Texas)
W70-06899

LIFE AND HEALTH ASSURANCE,
Westchester County Dept. of Public Works, N.Y.
Guy E. Griffin.
Journal of the Water Pollution Control Federation, Vol 40, No 7, p 1292-1297, July 1968. 6 fig, 3 ref.

Descriptors: *Safety, *Management, Waste treatment, Accidents, Costs, Operation and maintenance, Sewage treatment.
Identifiers: *Injury frequency rate, Collection, Responsibility.

Recent data indicating treatment plant accident rate are cited as being 7 times greater than that for 41 major industries. Several specific examples of poor safety practice are cited; for example, low level bridges where skulls are cracked and electrical fixtures in explosive areas near digesters. Design, operation and maintenance all play vital roles in achieving a good safety program. A well-constructed safety program is an important and necessary part of any facility in order to prevent a loss of life, injury, and to keep loss of work time at a minimum. Dangerous accidents can be avoided by employing a well-designed, strictly enforced safety program. Recent awareness of the problem will improve the safety outlook. (Hancuff-Texas)
W70-06900

SURVIVAL OF HUMAN PATHOGENS IN COMPOSTED SEWAGE,
Utah Univ., Salt Lake City.
B. Beauford Wiley, and Stephen C. Westerberg.
Applied Microbiology, Vol 18, No 6, p 994-1001, December 1969. 1 fig, 3 tab, 17 ref.

Descriptors: *Sewage, *Pathogenic bacteria, *Bacteria, Salmonella, Fungi, Viruses, Sludge, Thermophilic bacteria, Isolation.
Identifiers: *Survival, *Composting, *Thermosensitivity, Thermo-death time, Thermo-death point.

When sewage sludge is composted it is vitally important that the composting process be operated in such a way as to insure thermophilic bacteria activity. This bacterial activity is necessary to produce sufficiently high temperatures over an adequate period to render the composted product free from pathogenic organisms. Experiments conducted in this study were designed to determine if pathogens could possibly survive thermophilic temperatures present during composting. This was achieved by introducing indicator organisms into a composter and periodically testing for their survival. The composter fulfilled the requirements of thermophilic activity and maintained a temperature range within the compost from 60-70 deg C. The indicator organisms which were assumed representative pathogens were: Salmonella newport as typical bacteria, Polio virus Type I as virus, Aschris lumbricoides as metazoan parasite, and Candida albicans as fungus. Survival times at 60 deg C were determined to be 40 minutes, 5 minutes and 60 minutes for the first three, and 60 minutes at 70 deg C for C. albicans. It was shown that composting performed in this experiment (5 days at 60 - 75 deg C) was sufficient to destroy all indicator organisms. (Hancuff-Texas)
W70-06901

SALMONELLA IN WASTES PRODUCED AT COMMERCIAL POULTRY FARMS,
Rutgers - The State Univ., New Brunswick, N.J.
D. J. Kraft, Carolyn Olechowski-Gerhardt, J. Berkowitz, and M. S. Finstein.
Applied Microbiology, Vol 18, No 5, p 703-707, November 1969. 4 tab, 13 ref.

Descriptors: *Salmonella, *Poultry, Bacteria, Sampling, Pathogenic bacteria, Waste disposal, Farm wastes.

The potential of poultry excreta and manure from commercial farms to contaminate the environment with salmonella was determined. Composite samples of freshly voided excreta from 91 poultry houses were tested qualitatively for salmonella. Twenty-six (29%) were positive. Of the 36 farms tested, 18 showed positive samples. In a separate quantitative study salmonella densities ranged from less than 1 to over 34,000 per gram excreta (dry weight). Those samples from floor and caged birds were comparable with respect to the incidence of salmonella. As shown in a qualitative survey there were distinct differences. High densities of the pathogens were found in fresh excreta from caged but not floor birds. It is concluded that the spreading of these wastes could have disseminated substantial numbers of salmonella onto the soil possibly lending to the contamination of water via surface run-off. It is suggested that the recently developed plow-furrow-cover method of manure application may be advantageous in burying the waste thereby preventing its transport by surface run-off. (Hancuff-Texas)
W70-06902

DIVISION OF COST RESPONSIBILITY FOR WASTE WATER SYSTEMS,
Brookings Institution, Washington, D.C.; and Federal Water Pollution Control Administration, Washington, D.C.
James A. Johnson.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 341-353, March 1970. 1 tab, 9 ref.

Descriptors: *Cost, *Sewer, *Waste disposal, Waste water treatment, Allotment, Economics, Expenditures, Sewage disposal, Sewage treatment.
Identifiers: *Revenues, Equity, Responsibility, Authorities.

Cost of waste water collection and treatment systems are high and are likely to remain so because of emphasis on high water quality. They are met by a combination of general revenue, special assessments, service charges and grants; because costs are high it is important that they be allocated fairly among users, property owners, and the general public. A number of formulas, namely, Public utilities, differential benefits, historical, added expenditure, alternative revenue, capital and operating cost, relative use, and Joint Committee formulas have been proposed for the cost allocation. These vary greatly in the burden assigned to each group. Consideration of the nature of waste water service, benefits received by groups within society and responsibility of disposing of waste govern the allocation. (Hancuff-Texas)
W70-06903

USE OF CLARIFYING AGENTS FOR PURIFYING WASTE WATERS FROM RAYON PRODUCTION (IN RUSSIAN),
V. A. Mal'kov.
Vodosnabzh Sanitarna Technika, No 1, p 7-11, 1968.

Descriptors: *Analytical techniques, Iron compounds, Textiles, *Waste water treatment, *Fibers (Plant), Hydrogen sulfide.
Identifiers: *Rayon manufacturing plant, Rayon, Zinc compounds, Zinc ions, Sulfuric acid, Clarification.

Waste waters from rayon production contain H_2SO_4 21-2000, zinc-ion 10-150, iron calcium hydroxide, and suspended material 27-300 mg./l, (pH 1.7-2.8). Preliminary clarification by liming with 3-5% iron calcium hydroxide was very satisfactory, and the most efficient continuous clarifier was the slot type. At a settling rate of 1.4 mm./sec. 89% of the deposit could be removed and 87% of the zinc removed (zinc sulfate was converted to insoluble zinc hydroxide at pH 9.5-11).

The treated wastes then contained suspension of 56 and zinc of 4.6 mg./l. At a settling rate of 0.4-0.5 mm./sec. somewhat better results were obtained. The sludge carried off had 98-9% moisture, and the dry deposit averaged 3-4% of the waste volume. (Work-North Carolina State Univ)
W70-06904

PUBLIC RELATIONS--A SELF-ANALYSIS,
Iowa Univ., Iowa City.
Lane H. Mashaw.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 354-360, March 1970. 3 tab, 4 ref.

Descriptors: *Management, *Waste water treatment, Analysis, Surveys, Education, Government, *Attitudes.
Identifiers: *Operator, *Questionnaires, *Public relations, Associations, Opinions, Certification, Iowa.

A questionnaire was developed and mailed to 450 treatment plant operators to provide data on existing attitudes and activities in public relations upon the waste water treatment plant personnel in the state of Iowa. The results were divided into three groupings, those serving less than 1000 population, those serving between 1000 and 5000 and those serving more than 5000 population. The data sought were limited to three general headings: (1) How do my superiors view me. (2) How do I feel about my job. (3) Am I public relations oriented. The results of this study tend to confirm a long-standing contention that waste water treatment facility operators are among the most conscientious of employees, public or private. Their attitude towards public relations is very good and their concerted effort to attain good public relations is very bad. Recommendations are offered to the member associations of the Water Pollution Control Federation to be more active in training the operators in public relations tools and in fostering recognition of achievement by the operators. (Hancuff-Texas)
W70-06905

GREEN BAY, WISCONSIN-JOINT TREATMENT OF PULP MILL AND MUNICIPAL WASTES,
Charmin Paper Products Co., Green Bay, Wis.; and Green Bay Metropolitan Sewage District, Wis.
C. R. Faulkender, J. F. Byrd, and David W. Martin.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 361-370, March 1970. 7 fig.

Descriptors: *Pulp and paper industry, *Trickling filter, *Municipal waste, *Waste water treatment, Sewage treatment, Industrial waste, Pilot plant, Waste treatment, Biochemical Oxygen Demand, Activated sludge, Pulp wastes.
Identifiers: *Combined treatment, Green Bay (Wis), Contact stabilization, Krauss process, Yeast treatment.

Development of the waste treatment processes at the Charmin Paper Mill Plant is given, beginning with a yeast plant constructed in 1955 which was designed to remove 45-50% BOD. In 1957 further reduction in BOD was required by the state. A multiple effect evaporator concentrates the yeast plant effluent from 10 to 12% solids range to 55-60% range. At this concentration the material can be atomized into specially designed boilers where organic materials are burned. The combined facilities yeast plant evaporation and burning reduced the overall effluent BOD from pulping to more than 70%, an amount of 140,000 pounds of BOD. For further reduction in BOD, a laboratory and pilot-plant study was made. The study was made to determine the feasibility of combining the municipal waste with the industrial waste. Individual units were fed: (1) municipal waste, (2) industrial waste, (3) combined waste with nutrient addition, and (4) combined waste without nutrient addition. The industrial waste was adjusted to a pH of 6.5 - 7.5. The investigation demonstrated that Charmin waste was amenable to treatment in combination with municipal waste at the volume ratio of 1:20 and a BOD ratio of 1:1. Present research program is studying the operation parameters of four different continuous flow biological processes for combined treatment of municipal waste and dilute waste from the pulping process. The types are: (1) conventional, (2) contact stabilization, (3) separation, and (4) Krauss. (Hancuff-Texas)
W70-06906

POLLUTION CONTROL - FEEDLOT OPERATIONS,
Iowa State Univ., Ames.
J. R. Miner, E. R. Baumann, T. L. Willrich, and T. E. Hazen.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 391-398, March 1970. 1 tab, 6 ref.

Descriptors: *Livestock, *Pollution abatement, Waste disposal, Reservoirs, Waste treatment, Cattle, Sewage treatment, Farm wastes, Iowa, Hogs, Poultry.
Identifiers: *Feedlot, Population equivalent.

The increase in labor cost and a shortage of personnel has caused an increase in feedlot population. The result has been a concentration of livestock waste level. Techniques of feedlot waste systems design are reported, and methods of collecting and disposing of the waste are discussed. These cattle, swine, and poultry feedlot operations are similar. Types of flooring and methods of cleaning are discussed. Treatment and disposal of the waste are commented on, including tank storage and hauling, anaerobic lagoons, aerobic lagoons, surface irrigation systems and oxidation ditches. The limiting factors of various treatments in relation to feedlot waste are reported. Zoning regulations are suggested as a partial solution to nuisance complaints which are generated by concentration of livestock in feedlots. (Hancuff-Texas)
W70-06907

WASTE WATER TREATMENT AND RENOVATION STATUS OF PROCESS DEVELOPMENT,
Federal Water Pollution Control Administration, Washington, D.C.
David G. Stephan, and Robert B. Schaffer.
Journal of the Water Pollution Control Federation, Vol 42, No 3, p 399-410, March 1970. 1 tab, 1 ref.

Descriptors: *Waste water treatment, *Water reuse, *Research and development, *Grants, Pilot plants, Operational costs, Capital costs, Costs.
Identifiers: *Advance waste treatment, Development, Carbon adsorption, Nutrient removal, Renovation, Physical-chemical treatment, Suspended solids removal.

The advanced waste water treatment technology being developed and studied in the United States at the current time is tabulated. Over 350 studies in 95 categories of advanced waste treatment are listed. Some of the processes, although studied many years ago, have found renewed promise due to scientific breakthrough. Others, such as ultrafiltration, electro-osmosis, and plasma arc are indicative of the developing technology of the waste water treatment field. The study of modified activated sludge has increased more than three fold in two years. Advances have been seen since 1967 with the use of activated carbon and the number of projects on nutrient removal has doubled in two years. The independent physical-chemical treatment process, under study at several locations, is discussed extensively. Included in the tabulation are the treatment processes, scale, and location. (Hancuff-Texas)
W70-06908

EFFECT OF OXYGEN-TRANSFER CAPABILITIES ON WASTE WATER TREATMENT PLANT PERFORMANCE,
Milwaukee Sewerage Commission, Milwaukee, Wis.; and Rex Chainbelt, Inc., Milwaukee, Wis.
Raymond D. Leary, Lawrence A. Ernest, and William J. Katz.
Journal of the Water Pollution Control Federation, Vol 40, No 7, p 1298-1310, July 1968. 13 fig, 4 tab, 4 ref.

Descriptors: *Deficiency, *Aeration, Dissolved oxygen, Waste water treatment, Activated sludge, Performance, Biochemical Oxygen Demand, Diffusion, Mass transfer, Oxygen, Sewage treatment.
Identifiers: *Oxygen transfer, Layout.

Two activated sludge treatment plants at Milwaukee, Wisconsin were run in parallel. Marked changes in performance occurred when changes were made in the aeration systems. One of the systems was converted from a spiral flow plate diffusion system to a tapered aeration spiral flow ceramic diffuser system. The efficiency declined rapidly in spite of the diversion of part of the load to the other plant. BOD in the effluent went from 15 mg/l to between 40 and 50 mg/l. In addition, wasting of the sludge from the ailing plant to the return sludge of the other plant lowered the latter's efficiency until this practice was discontinued. A study of several diffusion patterns for oxygen transfer efficiencies showed that the spiral flow aeration basin had the lowest oxygen transfer efficiency and the ridge and furrow system the highest. The low efficiency plant improved its performance when diffuser plates were installed in a longitudinal pattern. (Hancuff-Texas)
W70-06909

TREATMENT OF COMBINED KRAFT AND NEWSPRINT EFFLUENTS AT AN ALABAMA PAPER MILL,
Kimberly-Clark Corp., Coosa Pines, Ala. Coosa River Newsprint Div.
B. J. Cottle, Jr., H. Newbauer, J. Buck, and R. M. Billings.
Journal of the Water Pollution Control Federation, Vol 40, No 7, p 1314-1331, July 1968. 10 fig, 7 tab, 2 ref.

Descriptors: *Industrial wastes, *Lagoon, Cost, Biochemical Oxygen Demand, Dams, Settling basins, Sewage treatment, Sludge, Pulp wastes, *Pulp and paper industry.
Identifiers: *Paper making, Thickening.

The oxygen content of water supplied to the paper mill on the Coosa river, Alabama will be greatly reduced when construction of a power dam is completed. Also, the raising of the height of a dam downstream will reduce the reaeration capabilities of the receiving waters. A 274 foot diameter primary clarifier, and 370 acre final lagoon were added to the existing facilities (a conventional lagoon system) and will permit removal of 97% of the effluent suspended solids, and 35% and 78% of the BOD in winter and summer respectively. The sludge is thickened from 5% to 18% through the use of centrifuges. The construction of under water weirs above the two upstream dams have increased the dissolved oxygen in the water supplied to the mill. The final lagoon allows release to the river to be coordinated with the river flows. The river requirements are such that a minimum of 4 mg/l DO is to be maintained. Capital cost of the treatment is approximately 2.5 million dollars, operating costs about $125,000 per year. (Hancuff-Texas)
W70-06910

1967 STATUS OF OPERATOR TRAINING AND CERTIFICATION IN THE UNITED STATES.
Water Pollution Control Federation, Washington D.C.

Journal of the Water Pollution Control Federation, Vol 40, No 7, p 1332-1337, July 1968. 2 tab.

Descriptors: *Survey, Waste water treatment, Treatment facilities, *Training, Permits.
Identifiers: *Certification, Operator training.

Two tables are presented reporting the 1967 status of waste water treatment plant operator training and certification in the United States. The firs

ible presents the state, program and level, text sed, sponsors and conducting group, attendance t the latest course, fee for the course and remarks. he second table presents the status of operators ertification. Tabulated are state, type of certifica- on and date adopted, number of operator grades, umber of operators certified, number of plants in ate, plants with certified operators, and remarks. Hancuff-Texas)
V70-06911

ONCENTRATION OF VIRUSES FROM EWAGE AND EXCRETA ON INSOLUBLE OLYELECTROLYTES,
aylor Univ., Houston, Tex. Coll. of Medicine.
or primary bibliographic entry see Field 05A.
V70-06912

RACE ELEMENTS AND THEIR ORIGIN IN A IETROPOLITAN WASTE WATER EFFLUENT,
or primary bibliographic entry see Field 05A.
V70-06915

CHICAGO'S SOUTH WATER FILTRATION LANT.

Chicago, Department of Water and Sewers and De- artment of Public Works, 1968, 9 p, 15 fig.

Descriptors: *Water treatment, *Water purifica- ion, *Filtration, *Filters, *Water supply, *Water vorks, *Treatment facilities, *Construction, Operations.
Identifiers: *Chicago Water Department.

This pamphlet is a brief, yet complete, overview of Chicago's expanded South Water Filtration Plant ocated at Lake Michigan near 79th Street. The plant is the second largest in the world, being ex- eeded in capacity only by its sister Central Water Filtration Plant near Navy Pier. The South Plant, placed in operation in 1947 with a rated capacity of 320 mgd, was expanded during the period 1961- 1967 to a rated capacity of 480 mgd with a capa- bility, if required, of 850 mgd. It now serves 1,900,000 persons. The major improvements in- cluded adding: 2 settling basins, making a total of 5; 40 sand filters, making a total of 120; 2 filtered water basins, making a total of 6, and one 150 mgd pump. Chemical storage facilities were increased to facilitate increased dosages of carbon and chlorine necessitated by the deterioration of the (Lake Michigan) raw water supply during recent years. The chemicals are used to achieve water stabiliza- tion to minimize corrosion and mineral deposits in pipes, as well as for combatting water pollution. The South Plant expansion program cost approxi- mately $12 million, financed from water revenues. A flow diagram, photographs, and discussion of the plant and operations are included. (Poertner-Chicago)
W70-06919

MANAGEMENT OF POLLUTION DATA USING MODERN TECHNIQUES,
Minneapolis-St. Paul Sanitary District, Min- neapolis, Minn.
Robert L. Callery.
Paper presented at the Annual and Environmental Meeting of the American Society of Civil En- gineers, Chicago, October 15, 1969. 18 p, 8 ref. FWPCA Facilities Demonstration Grant No. 1- Minn.-1.

Descriptors: *Data collection, *Data processing, *Data storage and retrieval, *Automation, *Instru- mentation, *Remote control, *Computers, *Con- trol systems, *Data transmission, *Telemetry, *Analytical techniques, *Regulated flow, *Remote sensing, *Flow control, *Sewers, Outlets, Ur- banization, Monitoring.
Identifiers: *Minneapolis-St. Paul Sanitary District, *Overflow regulators.

Modern techniques being used by the Minneapolis-St. Paul Sanitary District in a project involving acquisition and management of water pollution data are described. The project was initiated to develop a system for remote dispatching of combined-sewer flows through the interceptor sewers in the Minneapolis-St. Paul area, and to improve the performance of sewer overflow regulators. Real-time water quality data are transmitted automatically by leased telephone wires, from transducers located at stations on the Mississippi River to a central station. Depth measurements and overflow regulator gate positions in trunk sewers and in the interceptor sewer system, together with readings from 9 rain gages, can be logged automatically in a central station, at almost any frequency desired. Analog signals, after being converted to digital form, are presented to the processor for logging--or analysis, tabulation, correlation, or outputting. Programs supplied by the Sanitary District can scan and log, separately, each of four different reports: (1) River Quality Monitor report, (2) Overflow Regulator report, (3) Interceptor report and (4) Rain report. The use of the STORET System, in-plant data logging, and automatic analysis of sewage quality using the Technicon Auto-Analyzer are described. (Poertner-Chicago)
W70-06922

CHICAGO WATER SYSTEM, A DESCRIPTION OF THE SYSTEM AND ITS SANITARY PROTECTION.

City of Chicago Department of Water and Sewers, November 1966. 30 p, 8 fig, 3 tab.

Descriptors: *Water supply, *Water delivery, *Water distribution, *Water management, *Water structure, *Water works, *Waste water treatment, *Water purification, *Filtration, *Treatment facilities, *Distribution systems, Water costs, Construction, History, Construction costs, Operating costs, Urbanization.
Identifiers: *Chicago.

This pamphlet describes Chicago's water system and its sanitary protection. In the early days of settlement, Chicago dwellers drew their water supply directly from the Chicago River and Lake Michigan. As the population served grew from 178,500 at the end of the Civil War to its present 4.6 million in the metropolitan area of 402 square miles, the rivers and lakes have been polluted and vast networks of pumps, pipes, sewers and treatment plants had to be constructed to meet the demands of the people and industry. Thus, Chicago had developed and is operating one of the worlds largest water supply systems. Water is now obtained from Lake Michigan through two of four intake cribs located two to three miles offshore, and one shore intake at each of the two filtration plants. Ten pumping stations, each having 5 pumps, deliver more than one billion gallons per day through 4,083 miles of pipes. The newer and larger of Chicago's two filtration plants is the Central Plant which is capable of producing treated water at a rate of 1.7 billion gallons per day. It went into operation in 1964 and became, by far, the largest water treatment plant in the world. The South Plant, built in 1947, is the second largest plant in the world. Cost to the consumer is five cents per ton of water. This is the cheapest rate of all the major cities in the United States. (Poertner-Chicago)
W70-06923

MAIN STATION CONTROL,
Louisville Water Co., Ky.
For primary bibliographic entry see Field 08C.
W70-06924

USE OF UNICELLULAR ALGAE FOR PURIFYING WASTE WATERS FROM MAN-MADE FIBER PLANTS (IN RUSSIAN),
G. M. P. Mordvintseva, V. V. Grabovskaya, and V. K. Marinich.
Khimicheskie Volokna, Vol. 3, p 61-62, 1966.

Descriptors: *Algae, Iron compounds, Hydrogen sulfide, Biochemical Oxygen Demand, Nutrients, Waste water treatment, *Fiber (Plant).
Identifiers: *Viscose rayon plant wastes, *Man-made fiber plants, Nylon-6, *Viscose Rayon, Zinc compounds, Carbon disulfide.

Laboratory and pilot-plant experiments are reported on the use of unicellular green algae (Chlorella and Ankistrodesmus) to treat waste waters from the manufacture of nylon-6 and viscose rayon. Growth of the algae could be stimulated by addition of nutrients such as urea, magnesium sulphate, and potassium phosphate. It was found that treatment, which was complete within 6 days under laboratory conditions and 3 days in the open air, effected complete removal of zinc, iron, hydrogen sulphide, carbon disulphide, and sulphides, reduced the BOD by 90 percent, and increased the dissolved-oxygen concentration by 100-400 per cent, but had no effect on calcium and sulphates. (Livengood - Work-North Carolina State Univ)
W70-06925

CHICAGO'S CENTRAL WATER FILTRATION PLANT.
Department of Water and Sewers, Chicago, Ill.; and Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 08C.
W70-06927

ARE WE OR ARE WE NOT GOING TO CLEAN UP,
Metropolitan Sanitary District of Greater Chicago, Ill.
Vinton W. Bacon.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 354-367, 30 fig.

Descriptors: *Water quality control, *Flood control, *Lake Michigan, *Sewage disposal, Air pollution, *Fertilization, *Inland waterways, *Monitoring, *Tertiary treatment, Tunneling, Chlorination, Water sources.
Identifiers: *Sanitary District of Chicago, *Deep Tunnel Plan, *Combined sewage system, Stream cleaning, Microstraining.

Chicago efforts to improve water quality are outlined beginning in 1891 with the formation of the Sanitary District and the subsequent reversing of the Chicago River up to recent plans for sludge use and the deep tunnel project. Capacities of the various treatment plants are outlined and problems resulting from sewer construction and fertilizer drying operations discussed. The sanitary district is described as a wholesaler of sewage since it does not construct the local sewerage system. Improvements in construction of large sewage installations include tunneling because of its less disruptive effect on communities. Flood control with the Melvina Reservoir and plans for additional reservoirs are outlined along with plans for reduction of spillage to the lake with the deep tunnel project. The Ten-Year Program to upgrade waterways with chlorination facilities and tertiary treatment are suggested as ultimately allowing recreation involving full body contact, support of fish life, and service as a municipal water source. In addition to tertiary treatment, microstraining and an eleven-station monitoring system are suggested for improved waterways quality. Finally, means of disposing of the approximate one thousand tons per day of sludge are discussed. Costs of six alternative methods are presented along with limitations in disposal potentials of each. Because present methods account for approximately 40 per cent of the total operating budget and because use of sludge as fertilizer without drying could be considerably cheaper, special attention is directed toward its use in reclaiming farm lands and strip mines. (Preckwinkle-Chicago)
W70-06951

REMOVAL OF LIGNIN BY FOAM SEPARATION PROCESSES,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Civil Engineering.
T. E. Wilson, and M. H. Wang.
Paper, presented at the 25th Purdue Industrial Waste Conference, West LaFayette, Ind., May 6, 1970, 15 p., 3 fig, 4 tab, 11 ref. OWRR Project A-022-NJ.

Descriptors: *Lignin, *Foam separation, *Waste treatment, *Industrial waste treatment, Color, Water quality, Water quality control, Foam fractionation.
Identifiers: *Ion flotation.

Lignin is a compound difficult to remove from a waste water stream, and it appears to be the major source of color in natural waters. This paper reports on investigations into removing lignin by the process of foam separation. The method known as ion flotation achieved 98% removals of lignin on a color basis using cetrol or Arquad 2HT, over a wide concentration range. (Whipple-Rutgers)
W70-06955

THE ECONOMIC IMPACT OF DROUGHT ON WATER SUPPLY SYSTEMS IN THE PASSAIC RIVER BASIN, NEW JERSEY,
New Jersey Agricultural Experiment Station, New Brunswick.
A. Vaughn Havens.
Available from the Clearinghouse as PB-190 184, $3.00 in paper copy, $0.65 in microfiche. Report, December, 1969. 125 p, 19 tab, 31 fig, 41 ref, ESSA Grant WBG 86.

Descriptors: *Droughts, *Waste water treatment, *Costs, New Jersey, *Water supply, Water quality, *Economic impact, Evaluation, *Mathematical models, *Probability.
Identifiers: Drought probability, Passaic River basin.

The study was confined primarily to one adverse effect of the 1961-1966 drought for which good quantitative data were available. The Passaic Valley Water Commission supplies water to a densely populated and rather heavily industrialized section of northeastern New Jersey. The effect of the drought on water quality in the Passaic River at Little Falls and the subsequent effect on the water treatment costs of the Passaic Valley Water Commission are the principal subjects of this study. A closely related investigation of drought probability is also included in the final section of this report.
W70-06960

DILUTE SPENT KRAFT LIQUOR FILTRATION THROUGH WOOD CHIPS.
North Carolina State Univ., Raleigh. Dept. of Wood and Paper Science.

Available from the Clearinghouse as PB-191 873, $3.00 in paper copy, $0.65 in microfiche. Water Pollution Control Research Series report, April, 1970. 36 p, 9 tab, 4 fig, 3 ref, append. FWQA Program No. 12040 EUG.

Descriptors: Water pollution sources, *Waste water treatment, *Biochemical Oxygen Demand, *Pulp wastes, Pulp and paper industry, Industrial wastes, Effluents, Organic wastes.
Identifiers: *Kraft pulp mill, Biochemical Oxygen Demand-extraction, Wood chips, *Waste liquor.

The principal objective of this project was to determine if contact between effluent from a Kraft pulp mill and pine chips would reduce the water pollution characteristics of the waste liquor. The experimental work was divided into two phases: (1) a small scale laboratory investigation of contacting dilute waste liquor with chips; (2) a pilot-scale investigation of filtering waste liquor through a column and a pile of chips. It was found that contact of alkaline waste liquor, or even distilled water, with pine chips extracted organic matter from the chips which had a considerable BOD5. This extract corresponded to a pollution load of about 3-11 lbs. BOD5 per ton of dry wood. Alkalinity, pH, and intensity of color of the waste liquor were somewhat reduced by the contact. These reductions are, however, too small to have any practical application in effluent treatment. It can, in general, be concluded that contact of alkaline waste liquor, or water, with wood chips extracts soluble organics and adds pollutional materials to the effluent stream.
W70-06961

SURPLUS PHOSPHORUS UPTAKE BY MICROORGANISMS-BATCH TESTS WITH DILUTE ACTIVATED SLUDGE CULTURES,
Texas Univ., Austin. Center for Research in Water Resources.
Harry G. Moore, Jr., E. Gus Fruh, and Robert B. Higgins.
Technical Report No. 2, EHE-69-08, CRWR-41, Feb 1969, 44 p. 12 fig, 5 tab, 33 ref. FWQA Grant WP-01449-01.

Descriptors: *Phosphorus, *Phosphates, *Activated sludge, *Enzymes, *Biological treatment, Nutrients, Waste water treatment, Sewage treatment.
Identifiers: Alkaline phosphatase, Phosphorus uptake, Orthophosphate, Phosphorus removal, P-Nitrophenol phosphate.

An alkaline phosphatase assay based on the use of a P-nitrophenyl phosphate substrate was studied for its applicability to indicate 'surplus' phosphorus uptake by a dilute heterogeneous bacterial culture obtained from an activated sludge process. This investigation demonstrated the validity of the enzymatic bioassay using viable bacterial cells and determined conditions under which the bioassay should be conducted as a standard procedure. Alkaline phosphatase activity was found to be repressed by both orthophosphate external to the cells and by stored phosphorus within the bacterial cells. Based on these studies, the assay appears useful to help elucidate the mechanism responsible for the abnormally high phosphorus removal being attained by various activated sludge plants in the United States. The research also indicates the possible significance of the surplus phosphorus uptake phenomenon in waste treatment processes. (Makela-Texas)
W70-06964

POLYMERS IN WATER TREATMENT,
Union Carbide Corp. Chemical Div.
B. Mansfield.
Process Biochemistry, Vol 5, No 2, p 28-30, 1970. 4 fig, 3 tab, 6 ref.

Descriptors: *Oxides, *Fluid friction, Sewers, Slurries, Waste water treatment, Sludge treatment, Toxicity, Algae, Bacteria, Fish, Sewage sludge, Flow, Flocculation, Coagulation, Filtration, Viscosity.
Identifiers: *High-molecular-weight polymers, Turbulant frictional drag, Alkylene oxide, Polymerization, Ethylene oxide, Water clarification, Sludge drying, Polyethylene oxide polymers, Sewage settling, Union Carbide Corp, Polyox, Carbowax, Flocculant dosages, Baroco clay soils, Uranium ore.

The discovery and subsequent production by Union Carbide of high-molecular-weight polymers, such as Polyox, permits a reduction of surcharges in sewer pipelines. Injection of these polymers at concentrations of 45 to 200 ppm increases more than 100% the sewage flow, thereby eliminating the necessity of parallel pipes. The chemicals do not adversely influence bacteria or fish, or increase algal growth. They have no measurable biochemical oxygen demand, but improve sewage settling and sludge drying. Addition of the polymers to water-based slurry markedly decreases flow resistance. The polymers are highly effective agents for increasing settling and filtration rates of dispersed solids and facilitate water clarification. (Wilde-Wisconsin)
W70-06968

EXPERIENCES IN THE TREATMENT OF TEXTILE MILL WASTE WATERS ON A PERCOLATING FILTER (IN RUSSIAN),
J. Nosek, and V. Vondrlik.
Voda, Vol. 32, p 226-228, 1953.

Descriptors: *Biochemical Oxygen Demand, Color, Filters, *Waste water treatment, *Textiles.
Identifiers: *Textile mill wastes, *Coal slag, Dyehouse wastes, Dyestuffs, Percolating filters.

The waste waters from a dyeing, printing, and bleaching plant are treated successfully by filtration through a 1-m. layer of brown coal slag. The BOD is reduced by 35-45% and color is reduced by 80-90% and frequently completely removed. (Livengood - Work, North Carolina State University)
W70-06972

SLAG AS FILTER MATERIAL FOR TREATMENT OF TEXTILE MILL WASTE WATER (IN RUSSIAN),
J. Nosek, and V. Vondrlik.
Voda, Vol 33, p 14-15, 1953.

Descriptors: *Operation and maintenance, Filters, *Filtration, *Waste water treatment, Textiles.
Identifiers: *Textile mill wastes, Slag filter.

Information is given on the operation and maintenance of the slag filter for the treatment of textile mill waste waters. The upper layer of medium, to a depth of about 20 cm., must be loosened every 14 days. (Livengood-Work, North Carolina State Univ)
W70-06973

MECHANISM OF RAPID FILTRATION IN A UNIFORM FILTER BED,
Georgia Inst. of Tech., Atlanta.
T. F. Craft, and G. G. Eichholz.
Water Resources Research, Vol 6, No 2, p 527-537, April 1970. 11 p, 6 fig, 3 tab, 11 ref. OWRR Project B-020-GA.

Descriptors: *Filtration, *Flow, *Porous media, *Tracers, Radioactivity techniques, Particle size, Particle shape, Porosity, Cesium, Filters, Tracking techniques, Tagging.
Identifiers: Vermiculite.

A radiotracer study was carried out using cesium-137 labeled vermiculite particles to study the pattern of removal in a deep sand filter under rapid flow conditions. Sized sand and anthracite were used as bed media, and suspended particles were sized between 1 and 120 microns. By comparing the activity ratios in the upper bed levels, curves were obtained relating the filter coefficient to particle size and bed pore sizes. By analyzing the curves in relation to the various theories proposed to account for filter action, it was shown that interstitial sieving was the dominant mechanism down to a nominal pore-particle ration of 4. Below this ratio, van der Waals forces were adequate to explain residual removal effects, and the effective range of those forces was calculated. (Knapp-USGS)
W70-06990

EFFLUENTS FROM DYEING AND FINISHING BATHS (IN FRENCH),
E. Peyron.
Teintex, Vol. 32, No. 6, p 410, 421-422 and 425, 1967.

Descriptors: *Effluents, *Flocculation, *Activated carbon, Aeration, Calcium chloride, Waste water treatment, Textiles.
Identifiers: *Dyehouse wastes, *Textile finishing plant wastes, *Effluent treatment, *Auto neutralization, Effluent combination, Equalization bath, Aluminum sulphate, Sodium silicate, Textile mill wastes, Dyehouse waste.

The treatments of dyeing and desizing effluents used in the textile industry were discussed. The autoneutralization, pH regulation, flocculation, decolorization by carbon and decantation processes involved were discribed. The installation steps used for a textile printing plant were discussed. The various effluents were combined in an equilization bath provided with a surface skimming device and an aeration system by compressed air. Flocculation is carried out by Al2 (SO4)3 and Na silicate in a special tank. CaCl2 used for decolorization is distributed automatically and is controlled by a galvanometric device. (Mattox and Livengood-North Carolina State University)
W70-07018

TREATMENT OF WASTE WATERS OF THE TEXTILE WORKS HERMANN WINDEL G.M.B.H. IN WINDELSBLEICHE NEAR BIELEFELD (IN GERMAN),
F. E. Hess.
Wasser und Boden, Vol. 9 p 474-475, 1957.

Descriptors: *Irrigation, *Waste Water Treatment, Baffles, Aeration, Sedimentation, Lagoons, Textiles, *Fibers (Plant).
Identifiers: *Textile mill wastes, *Artificial rain, Dilution, Cascades.

As the dilution available for the waste waters of a textile factory at Windelsbleiche is small, the waste waters are treated by irrigation and as artificial rain after sedimentation for 8-10 hours. The area used for disposal is drained and the drains discharge into a pond with a retention time of about 3 days from which the effluent flows to the stream. Baffles and cascades at the inlet and outlet of the pond ensure intensive aeration. Efforts are being made to reduce the load on the land and improve results by separate preliminary treatment of waste waters from different processes. (Livengood and Robinson - North Carolina State University)
W70-07020

PHOSPHATE REMOVAL: SUMMARY OF PAPERS,
FMC Corp., Panorama City, Calif. Water Pollution Div.; and FMC Corp., Chicago, Ill. Pump Div.
Milton Spiegel, and Tom H. Forrest.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA5, Paper 6807, p 803-815, October 1969. 13 p, 16 ref.

Descriptors: *Waste water treatment, *Phosphates, *Reviews, Tertiary treatment, Water pollution control, Phosphorus, Activated sludge, Sewage treatment, Waste disposal, Eutrophication, Bibliographies.
Identifiers: Phosphate removal.

Summaries are given of 16 papers presented at a Federal Water Pollution Control Administration Conference on Phosphorus Removal from Wastewater at Chicago in June, 1968. These summaries are of processes comprising chemical precipitation, employing lime or alum and various means for solids separation; activated sludge removal; reverse osmosis; metallic salts and polyelectrolytes; activated bentonite compound; and activated algae. (Knapp-USGS)
W70-07021

ACID PROTECTION AND EFFLUENT TREATMENT IN THE TEXTILE INDUSTRY (In German),
W. Heynemann, and H. J. Bradke.
Spinner Weber Textilver, Vol. 84, No. 8, p 850-857, 1966.

Descriptors: Waste water treatment, *Textiles, Fibers (Plant), *Effluents.
Identifiers: *Acid protection, *Acid resistant tiles, Polyisobutylene, Bitumer, Effluent treatment tanks.

Special treatments to prevent attack by acid on floors of workshops are described; films of polyisobutylene offer short-term protection but bitumen or acid-resistant tiles are needed for permanent protection. A short survey of small-scale effluent treatment tanks is given. (Livengood and Robinson - North Carolina State University)
W70-07025

NITRIFICATION AND DENITRIFICATION IN A MODEL WASTE STABILIZATION POND,
Texas Univ., Austin. Center for Research in Water Resources.
Jorge Aguirre, and Earnest F. Gloyna.
Environmental Health Engineering Research Laboratory, Report EHE-05-6701, CRWR-19, June 1967. 82 p, 22 fig, 5 tab, 38 ref. FWQA Contract WP-00688-38.

Descriptors: *Denitrification, Efficiencies, *Nitrification, Nitrogen compounds, Nitrogen cycle, Algae, Biological treatment, Bottom sediments, Nutrients, *Waste water treatment, *Oxidation lagoons, Milk, *Model studies.
Identifiers: *Facultative lagoons, Laboratory model, COD removal, Milk substrate, Nitrogen removal, *Milk wastes.

A laboratory model of a facultative waste stabilization pond was used to investigate nitrification and denitrification of milk wastes as a function of depth. The model was operated on a semi-continuous flow basis using a dry milk product as feed. The organic and hydraulic loading were kept constant at 50 lb BOD5/acre/day and 3 inches/day (5 gal/d), respectively. General pond characteristics were evaluated by measuring D.O., pH, ORP and temperature profiles; COD and the different forms of nitrogen were monitored at frequent intervals during the test period to determine depth profiles of these parameters as well COD removal efficiencies and nitrogen transporations. A rapid removal of organics occurred in or near the bottom sediment layer with a correspondingly high degree of ammonification. Above the sludge layer the contents remained essentially unchanged except for minor variations due to algal density fluctuations. Detectable concentrations of nitrates were not found during the test period, but a substantial amount of nitrogen was lost from the liquid fraction. COD and nitrogen removals from the waste water, as measured by the overflow, were 85% and 44% respectively. (Aguirre-Texas)
W70-07031

RESPONSE OF ACTIVATED SLUDGE ON TRANSIENT LOADING,
Texas Univ., Austin. Center for Research in Water Resources.
Carl E. Adams, and W. Wesley Eckenfelder, Jr.
Environmental Health Engineering Research Laboratory, Report EHE-69-04, CRWR-37, January 1969. 260 p, 51 fig, 26 tab, 46 ref.

Descriptors: *Activated sludge, *Kinetics, *Organic loading, Biochemical oxygen demand, Chemical oxygen demand, *Waste water treatment.
Identifiers: *Transient loadings, Laboratory studies, Oxygen uptake, Steady state, Substrate removal, Total organic carbon.

This study evaluates the acute and chronic effects of organic loading of a given waste on activated sludge systems under steady state conditions and compares these responses to the results obtained from transient studies using average organic loadings. Also examined were conventional substrate removal and oxygen uptake kinetic models, previously justified for steady state use, to determine if they could be employed to predict system responses under transient loadings. Three different wastes were used, a synthetic, an industrial, and a domestic waste water. Each study consisted, generally, of a steady state phase and several transient phases in which both the magnitude and the duration of shock loading were varied. Conventional kinetic models expressing the substrate removal rate as a function of growth-limiting substrate remaining in solution and predicting the oxygen requirements were shown to apply satisfactorily to both steady state and transient state conditions of the activated sludge process. It was demonstrated that systems can tolerate applied transients, up to three times the normal loading for 12 hours per day, for several days without showing any significant increase of effluent soluble organic matter. (Aguirre-Texas)
W70-07032

RELATIONSHIPS BETWEEN SELECTED PHYSICAL PARAMETERS AND COST RESPONSES FOR THE DEEP-WELL DISPOSAL OF AQUEOUS INDUSTRIAL WASTES,
Texas Univ., Austin. Center for Research in Water Resources.
Joe Clifton Moseley, II, and Joseph F. Malina, Jr.
Environmental Health Engineering Research Laboratory Report EHE 07-6801, CRWR-28, August 1968. 276 p, 51 fig, 13 tab, 175 ref. Public Health Service Grant EH-68-610-B.

Descriptors: *Computer models, *Cost analysis, *Economic prediction, *Injection wells, Equations, Performance, Ultimate disposal, *Waste water disposal, *Industrial wastes.
Identifiers: Aqueous wastes, Computerized design, Economic data.

The objectives of this investigation were: (a) to develop the equations and the systems of equations governing the performance of an injection well, (b) to collect economic data on the components of such a system, (c) to develop a computerized design and cost model giving the cost responses to the input variables, (d) to test this model on many feasible input data combinations, and (e) to develop generalized relationships between physical conditions and the costs of injection. Physical relationships in common usage in the petroleum industry were modified where necessary and used to describe the behavior of the injection system. Cost data were collected from a variety of sources, especially the petroleum and chemical engineering fields. The results of this study indicate that deep well injection of aqueous wastes is both technically and economically feasible under certain conditions. The cost of this operation may run upward from a minimum of 0.25 - 0.40 dollars per thousand gallons, including minimal pre-injection treatment and amortization of the initial capital investment. The capital cost of such systems appears to vary from $0.30 to over $2.00 per thousand gallons per day for a 10 to 0.10 MGD system, respectively. (Aguirre-Texas)
W70-07033

SULFIDE PRODUCTION IN WASTE STABILIZATION PONDS,
Texas Univ., Austin. Center for Research in Water Resources.
Ernesto Espino de la O, and Earnest F. Gloyna.
Environmental Health Engineering Research Laboratory, Report EHE-04-6802, CRWR No. 26, May 1967. 156 p, 50 fig, 33 tab, 75 ref. FWQA Contract WP-00688-03.

Descriptors: *Hydrogen sulfide, *Organic loading, *Sulfates, *Sulfides, Algae, Gases, Odor, Oxidation-reduction potential, Sulfur bacteria, *Waste water treatment, *Oxidation lagoons, *Model studies.
Identifiers: Detention time, Laboratory models, BOD removal rates, Design applications, Facultative ponds, Infrared spectroscopy, Sulfur compounds, Waste stabilization ponds.

Laboratory models, under controlled environmental conditions, were used to investigate the production and release of hydrogen sulfide from waste stabilization ponds. A 6 foot deep model facultative pond was studied under seven different operating conditions. The experiments evaluated the relationship between sulfide concentration in the pond

and four operating characteristics: detention, concentration of sulfate ion in the influent, BOD surface load and sulfate ion concentration in terms of surface load. At constant detention time and BOD surface load, a linear relationship was found to apply between sulfide concentration in the pond and sulfate concentration in the influent. Increases in sulfide concentrations in the pond from zero to 1 and 2 mg/l were accompanied with drops in oxidation-reduction potentials of 80 and 120mv, respectively. Further increases in sulfide concentration affected the ORP in a lesser way. Sulfide concentrations in the pond of about 7 mg/l were accompanied by an almost complete disappearance of algae, but the BOD removal rates were not appreciably affected. Infrared spectroscopy was used to identify methane, hydrogen sulfide and carbon dioxide in the gaseous emissions from the pond. (Aguirre-Texas)
W70-07034

EXPANSION OF SOUTH CHARLESTON WASTE TREATMENT PLANT,
Union Carbide Corp., South Charleston, W. Va.
R. A. Payne, G. W. Kumke, and A. H. Cheely.
Journal of the Water Pollution Control Federation, Vol 41, No 4, p 535-546, April 1969. 6 fig, 4 tab, 3 ref.

Descriptors: Expansion, *Biomass, *Biochemical Oxygen Demand, Activated sludge, Aeration, Pilot plant, *Waste water treatment, Municipal waste, Industrial waste, West Virginia.
Identifiers: Plant design, *Secondary treatment, *Aerobic reactors, *Clarifiers, Aeration basin, Aerators, pH control, Charleston (W Va).

The 1968 expansion of the South Charleston, West Virginia, waste water treatment plant provide secondary treatment for an average municipal-industrial waste flow of 17 mgd increasing the plant biochemical oxygen demand removal from 40,800 lb/day to 103,000 lb/day. Two pilot-plant systems, 55 gal baffled drum aerobic reactors with biomass recycled continuously from an insulated clarifier, were operated in parallel to establish operating parameters. The nitrogen demand of the biomass was 5% of BOD5 removed. Data indicated that 1.2 lbs of oxygen were consumed per lb of BOD5 removed; 90% reduction of BOD5 was achieved in 10 hours; a straight line relationship was established between solids accumulation per pound of BOD5 removal/day and detention time. The resulting expansion equipment include a unique ash cement lined 6.5 mil gal aeration basin, 18 surface aerators, 2 final clarifiers, recycle pumps, sludge pumps, modifiers to pH controls, and instrumentation. (Waid-Texas)
W70-07035

RAPID INSTRUMENTAL MEASUREMENT OF ORGANIC LOAD IN WASTE WATERS,
Rocketdyne, Canoga Park, Calif.
I. Lysyj, K. H. Nelson, and H. Snell.
Journal of the Water Pollution Control Federation, Vol 41, No 5, p 831-835, May 1969. 1 fig, 2 tab, 3 ref.

Descriptors: *Biochemical oxygen demand (BOD), *Laboratory equipment, *Effluents, Organic matter, Organic loading, Treatment facilities, Instrumentation, Measurement, *Analytical techniques.
Identifiers: *Pyrolysis, Pyrographic technique, Non-biodegradable matter.

Equipment, proceedures and calculations of a pyrographic technique for the determination of total organic content of waste waters are described. Results are calculated as oxygen demand similar to those from the biochemical oxygen demand (BOD) test. Application of this technique to raw waste water and primary treated effluents produced results differing by only 5% from parallel standard 5-day BOD determinations. Relative amounts of biodegradable and nonbiodegradable components of secondary treated effluents were predicted when the pyrographic technique results were compared with 5-day BOD test results. (Sorber-Texas)
W70-07037

NEW YORK'S HUDSON RIVER BEND COMPREHENSIVE SEWERAGE STUDY,
Rist-Frost Associates, Glens Falls, N.Y.
M. Vonic, and J. C. Bumstead.
Journal of the Water Pollution Control Federation, Vol 41, No 4, p 553-566, April 1969. 13 fig, 2 tab, 4 ref.

Descriptors: *Sewerage, *Waste water (Pollution), *Pollution abatement, *Economics, *Industrial waste, *Municipal waste, *Costs, River flow, Stream gauges, Biochemical oxygen demand, Dissolved oxygen, Liquid waste, Treatment facilities, New York.
Identifiers: *Waste characteristics, *Hudson River, Population growth, Hudson River (NY).

This paper describes a workable engineering framework of a $26,000,000 plan for the implimentation of two treatment plants, one to treat 32.5 mgd and the other, 6.4 mgd of combined municipal and industrial wastes, which would reduce and control pollution of the Upper Hudson River. The plants would serve 8 municipalities and four major industries (paper and dye) around the city of Glens Falls. The size of the plants is the result of a study which estimated the population to be 100,000 by year 2000. The study also analyzed the river flow and indicated the major portion of the waste loadings to be of an industrial nature and based on biochemical oxygen demand the equivalent population presently affecting the study area is 550,000 - 9 times the actual population. The report recommends a Tri-county Sewer District Agency be created to administer the proposed sewer district allocating the cost of the treatment plant on the basis of flow, biochemical oxygen demand, and suspended solids. (Waid-Texas)
W70-07038

AERATION IN WASTE WATER TREATMENT - MOP 5.
Water Pollution Control Federation, Washington, D.C. Technical Practice Committee.

Journal of the Water Pollution Control Federation, Vol 42, No 1, p 51-76, January 1970. 2 fig, 6 tab, 116 ref.

Descriptors: *Aeration, *Waste water treatment, Analytical techniques, *Operation and maintenance, *Maintenance, Operations.
Identifiers: Aerators, *Air diffusers, *Mechanical aerators, *Diffuser cleaning, Air blowers, Air filtration, Air piping.

This report is the third and concluding installment of the serialization of the manual 'Aeration in Waste Water Treatment.' The manual is intended to provide designers, operators, and maintenance personnel of waste water treatment facilities with the fundamental theory and operational aspects of aeration. This third installment deals with the operation and maintenance of the diffuser system. The report indicated that proper records should be kept showing the pertinent information to insure proper service. Causes of diffuser clogging and techniques for cleaning diffusers is presented. The report also presents the operation and maintenance procedures for various types of air filters, mechanical aerators and connected aeration equipment, such as air piping, distribution control, air blowers and gear motors. (Waid-Texas)
W70-07039

COMBINED TREATMENT OF WOOL SCOURING WASTES AND MUNICIPAL WASTES,
A. Petru.
Journal of the Institute of Sewage Purification, No 5, p 497-499, 1964.

Descriptors: *Municipal wastes, Calcium hydroxide, Calcium chloride, Centrifugation, Biochemical Oxygen Demand, Chemical Oxygen Demand, Textiles, Fibers (Plant).
Identifiers: *Wool scouring wastes, Wool, Wool grease, Wool scouring.

Pilot-plant experiments showed that, after pretreatment with calcium hydroxide and calcium chloride and a centrifuging treatment to remove as much wool grease as possible, wool scouring wastes can be treated together with municipal wastes in a ratio of 1:10. Reduction in BOD was of the order of 70 percent and that in COD of 40-60 percent. (Mattox and Livengood-North Carolina State Univ)
W70-07040

DISPOSAL OF EFFLUENT,
Shirley Inst., London (England).
D. W. Hill.
Textile Weekly, Vol 65, No 2, p 841-842, 1965.

Descriptors: *Activated sludge, Biochemical oxygen demand, *Trickling filters, Biological treatment.
Identifiers: *Dyehouse wastes, *Finishing waste.

A washing parameter concept allows the calculation of possible efficiency in the washing process, and its use may enable a plant to save several thousand gallons of water per day at one process. Organic matter in a plant's effluent solution can be oxidized to simple substances by bacteria in the presence of dissolved oxygen, reducing the effluent's biochemical oxygen demand. Process efficiency depends on the concentration of organic matter and the presence of inorganic materials that may assist or interfere with the microorganisms. Two main methods of biological purification are the trickling filter and activated sludge. (Sheffield and Work-North Carolina State Univ)
W70-07041

THE ADVANTAGES OF INDUSTRIAL-MUNICIPAL WASTE WATER TREATMENT,
General Electric Co., Schenectady, N.Y.
K. S. Watson.
Journal of the Water Pollution Control Federation, Vol 42, No 2, Part 2, p 209-217, February 1970. 1 fig, 4 tab, 15 ref.

Descriptors: *Municipal wastes, *Industrial wastes, Economics, Financing, *Waste water treatment, Regions.
Identifiers: *Sanitary district, *Joint treatment, Equitable finance formula, Combined treatment.

Combining the wastes from the industries and municipalities in a regional system provides the most economic treatment for an area, and since the operation is larger, full-time professional operation and management is improved. In planning the regional approach a study of the area under consideration is required, which is accomplished when either municipilities or industries takes the lead and start organizing study committees. Once the sanitary district is established, its powers are exercised by or through a board of governors, directors, or trustees. Five cases illustrating aspects of this approach are given. Limits are set for acceptance of industrial waste to protect the treatment plant. Seven approaches for financing the handling of waste water and their merits are presented. In spite of the soundness of the joint approach it is not practiced widely due to the inability of the political sub-divisions of a region to get together. (Waid-Texas)
W70-07042

AGGREGATE SIZE VARIATIONS DURING THICKENING OF ACTIVATED SLUDGE,
Illinois Univ., Urbana. Sanitary Engineering Lab.
Ali R. Javaheri, and Richard I. Dick.
Journal of the Water Pollution Control Federation, Vol 41, No 5, Part 2, p R197-R214, May, 1969. 31 fig, 19 ref.

Descriptors: *Activated sludge, *Aggregates, *Settling velocity, *Waste water treatment, Porosity, Separation techniques, Solid wastes.
Identifiers: *Settling characteristics, *Aggregate size, Thickening, Solids separation.

This study investigates the fundamental physical behavior of activated sludge during thickening to determine the effectiveness of the solids separation and consolidating phases. Settling tests were conducted on samples from three different activated sludge treatment plants using four 3.5 inch diameter columns, reservoirs, pumps, and a piping system. Sludge was pumped to a height of 3.5 feet in the columns insuring a homogeneous distribution of solids. Subsidence of the sludge interface was then observed and analyzed for interface subsidence velocity and for the water content and size of aggregates. The data analysis showed that aggregate became smaller, more numerous, and more dense as thickening takes place and water elimination depended on two mechanisms: 'squeezing' and 'splitting.' Activated sludges with good settling characteristics have low ASI, aggregate squeeze index, and high porosity, and thickening occurs primarily by elimination of interstitial water. In contrast, sludges with poor settling characteristics have high ASI and low porosities. (Waid-Texas)
W70-07043

MASS TRANSFER LIMITATIONS IN SUBSTRATE REMOVAL,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
C. Robert Baillod, and William C. Boyle.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No SA2, p 525-545, April 1970. 11 fig, 1 tab, 31 ref. FWQA Research Grant WP-00905-03.

Descriptors: Bacteria, Diffusion, *Diffusivity, *Flocculation, Hydraulic models, *Activated sludge, *Mass transfer, Sanitary engineering, Waste water treatment.
Identifiers: *Oxygen uptake rates, *Glucose uptake rates, Zoogloea ramigera.

This paper establishes the existence of an intraparticle diffusional resistance in the uptake of organic substrate by particles of zoogloeal floc, Zoogloea ramigera, strain I-16-M, by comparing the glucose and oxygen uptake rates for large floc particles with those exhibited by the same particles after blending. The results showed that, at high glucose concentrations (above 2 mg/l to 8 mg/l) the oxygen and glucose uptake rates of both the flocculated and blended particles exhibited zero order kinetics and thus independent of glucose concentrations. A zero order effectiveness factor model predicting the magnitude of mean effective diffusivity for glucose in the floc material to be 2.625 x 10 to the -8th power (T C)-9.75 x 10 to the -8th power in square centimeters per second for the range 20C to 30C, is developed by considering the floc particles to be analogous to a porous catalyst particle. In a similiar experiment, subjecting activated sludge floc particles to high turbulence caused a marked increase in the oxygen uptake rate, apparently due to the solubilization of some sludge components. (Waid-Texas)
W70-07044

BEEF FEEDLOT OPERATIONS IN ONTARIO,
Department of Energy, Mines and Resources, Burlington (Ontario). Canada Centre for Inland Waters.
A. R. Townsend, S. A. Black, and J. F. Janse.
Journal of the Water Pollution Control Federation, Vol 42, Part 1, p 195-208, February 1970. 3 fig, 10 tab, 10 ref.

Descriptors: *Livestock, *Farm mangement, *Farm lagoons, *Runoff, Seepage, Waste storage, Waste disposal, *Farm wastes.
Identifiers: *Cattle feedlots, *Animal housing, *Manure storage.

The beef feedlot industry in Ontario is described with respect to its environmental pollution problem. Approximately 100,000 cattle are on Ontario feedlots with an estimated 300 heat or less per feedlot. Four different types of housing and the associated handling of animal wastes as well as types of pollution from the feedlots is discussed. Animal waste storage should be designed to provide six months capacity and lot runoff storage facilities should be sized to hold the winter snow melt and spring rains until proper waste disposal. The report concludes that feedlot waste disposal will continue to be storage and land disposal rather than treatment and effluent discharge. The three main causes of pollution have been feed storage seepage, feedlot runoff, and land disposal runoff. This report recommends aeration systems such as rotors, aspirators, surface mechanical, and diffused air tubing for odor control. (Waid-Texas)
W70-07045

HYDRAULIC DESIGN OF SELF-CLEANING SEWAGE TUNNELS,
Norges Tekniske Hoegskole, Trondheim.
Dagfinn K. Lysne.
Journal of the Sanitary Engineering Division, ASCE, V 95, No SA1, p 17-36, February, 1969. 15 fig, 8 ref.

Descriptors: *Design, *Tunnel design, Dimensions, Hydraulics, Shape, Slopes, *Sewage.
Identifiers: *Sewage tunnels.

The different factors affecting the hydraulic design of self-cleaning sewage tunnels with a free water surface are described. It is found that the two most important problems involved are related to shear stress distribution and critical shear stress to secure self-cleaning. Based on a shear stress distribution normally assumed for open channels, a trapezoidal bottom shape is suggested. A value for critical shear stress to prevent settlement of sand in a mixture of waste water is recommended, but design data are also included for alternative values of critical shear stress. Curves for determining shape, slope, and size of tunnels with known minimum and maximum rate of flow are given. (DiFilippo-Texas)
W70-07046

A COMPARISON OF STONE-PACKED AND PLASTIC-PACKED TRICKLING FILTERS,
Eastman Kodak Co., Rochester, N.Y.
Bruce A. Wing, and William M. Steinfeldt.
Journal of the Water Pollution Control Federation, Vol 42, No 2, Part 1, p 285-264, February 1970. 18 fig.

Descriptors: *Biological treatment, *Pilot plant, *Trickling filters, *Waste water treatment, *Biochemical oxygen demand, Neutralization, Nutrients, Industrial waste, Efficiency, Aeration.
Identifiers: *Recirculation, *Secondary treatment, *Stone filter, *Plastic-packed filter, Zinc pH control, Hydraulic loading, Forced-air ventilation.

A 21 ft diameter stone filter and a 3 ft diameter plastic-packed filter were compared using the primary treatment plant effluent that had been pumped through a neutralization tank. The pH was controlled using 40% H2SO4 and 20% NaOH. The results showed that pH control was mandatory if the pH varied outside the range of 5.0 to 9.0. Forced-air ventilation improved the performance of a stone-packed filter by 14% and recirculation by 36%. Both filters achieved over 80% removal. Zinc concentrations as high as 8 mg/l and nutrient additions did not affect efficiency. Hydraulic loading was the only variable influencing the plastic-packed filter efficiency and the plastic media 21.5 ft in depth required less than one-fifth of the land area required by an 8 ft. deep stone-packed filter. (Waid-Texas)
W70-07048

5E. Ultimate Disposal of Wastes

SLUDGE HANDLING,
Potter (Alexander) Association, New York.
For primary bibliographic entry see Field 05D.
W70-06891

ALTERNATIVES FOR SLUDGE DISPOSAL, METROPOLITAN SEWERAGE SYSTEM,
San Diego Dept. of Utilities, Calif.
Harvy M. Cole, Jr.
November 1968. 85 p, 9 fig, 11 ref.

Descriptors: *Sewage disposal, *Sludge disposal, *Oceanography, *Sludge treatment, *Water quality control, *Costs, *Landfills, *Hydraulic conduits, Incineration, Deserts.
Identifiers: *San Diego, *Sewage sludge disposal.

The problems and alternatives in the handling and disposal of sewage sludge from the San Diego Metropolitan sewerage system are described. San Diego has a continuing problem of finding sites for solid wastes disposal. For the next 10 years though, the canyons surrounding Miramar Air Station will be used for sanitary fill operations. On the basis of cost factors only, three basic alternatives that are suited to the San Diego area are compared. The classifications are: (1) Ocean Disposal, (2) Combustion and Ash Disposal, and (3) Land Disposal of Liquid Sludge. It was concluded that hauling wastes to the desert and various methods of incineration are expensive and should not be considered unless after alternatives of land and ocean disposal prove to be unacceptable. Combustion of sludge has disadvantages. The present method of shipping waste to Fiesta Island is highly desirable and the cost is low, but may be terminated soon. Disposal to the ocean through an outfall is advantageous but is not permitted by present policies of the Water Quality Control Board. Further research is suggested. (Poertner-Chicago)
W70-06916

LIQUID WASTE DISPOSAL IN THE LAVA TERRANE OF CENTRAL OREGON,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
For primary bibliographic entry see Field 05B.
W70-06962

LIQUID WASTE DISPOSAL IN THE LAVA TERRANE OF CENTRAL OREGON (Appendix),
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
For primary bibliographic entry see Field 05B.
W70-06963

DISPOSAL OF EFFLUENT,
Shirley Inst., London (England).
For primary bibliographic entry see Field 05D.
W70-07041

5F. Water Treatment and Quality Alteration

A STEADY STATE OPTIMAL DESIGN OF ARTIFICIAL INDUCED AERATION IN POLLUTED STREAMS BY THE USE OF PONTRYAGIN'S MINIMUM PRINCIPLE,
Rutgers - The State Univ., New Brunswick, N.J.; and Electronic Associates, Inc., Princeton, N.J.
Burton Davidson, and Robert W. Bradshaw.
Water Resources Research, Vol 6, No 2, p 383-397, April 1970. 15 p, 13 fig, 1 tab, 17 ref. OWRR Projects, A-017-NJ and B-011-NJ.

Descriptors: *Aeration, *Water pollution treatment, *Optimization, *Computer programs, Digital

computers, Analog computers, Systems analysis, Synthetic hydrology, Costs, Cost analysis, Cost-benefit analysis, Dissolved oxygen, Mathematical models.
Identifiers: Control theory.

Optimal control theory based on Pontryagin's minimum principle was applied to the steady state distribution of artificial aeration in polluted rivers. The optimization was developed for a general integral type cost functional with weighted energy constraints. The system equations used were of the classical Streeter-Phelps type with an induced aeration term added as the control function. Several optimal and suboptimal aeration designs at different temperature levels were obtained using a digital computer and an automatic plotting routine. An analog computer was used in the critical stages of the numerical solutions. Results from the analog computer pointed the way to the ultimate use of Laplace transform techniques in conjunction with a digital computer for maximum accuracy. (Knapp-USGS)
W70-06743

INNOVATION IN MEMBRANE FILTER TECHNIQUE AS APPLIED TO WATER BACTERIOLOGY,
Denver Board of Water Commissioners, Colo.
For primary bibliographic entry see Field 05A.
W70-06914

5G. Water Quality Control

AIR-SEALING COAL MINES TO REDUCE WATER POLLUTION,
Bureau of Mines, Pittsburgh, Pa. Coal Mining Research Center.
N. N. Moebs, and Stephen Krickovic.
Bureau of Mines Report of Investigations 7354, March 1970. 33 p, 21 fig, 5 tab.

Descriptors: *Acid mine water, *Water pollution control, Oxidation, Oxygen, Waterproofing, Mine drainage, Water pollution treatment, Mine acids, Acid streams.
Identifiers: Mine sealing.

The Bureau of Mines air-sealed a 77-acre, above-drainage coal mine to evaluate sealing as a means of reducing the acid and metallic salt contents in drainage from abandoned mines. An approximate reduction in acidity of 150 ppm (equivalent to 193 pounds per day) and in iron of 98 ppm were directly attributed to sealing. The topographical, hydrological, and other factors involved in air-sealing are discussed, and the construction used to seal the mine is described. (Knapp-USGS)
W70-06734

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOLUME II, APPENDIX.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-06839

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOLUME III, (SEWERAGE CHARGES).
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-06840

CONNECTICUT'S ADMINISTRATIVE CONTROL OF WATER POLLUTION -- THE FLUID ADMINISTRATIVE PROCESS,
Connecticut Univ., Inst. of Water Resources.
Theodore H. Focht.
Available from the Clearinghouse as PB-191 872, $3.00 in paper copy, $0.65 in microfiche. Connecticut University Water Resources Institute Report No 8, April 1969. 44 p, 76 ref, 3 append. OWRR Project A-012-CONN (3).

Descriptors: *Water pollution control, *Connecticut, Legal aspects, Regulation, Water law, Legislation, Public rights, Water policy, Water distribution (Applied), Water utilization, Water quality.
Identifiers: Conneticut water pollution control.

The present status of administrative regulation of water rights in Connecticut is outlined, especially as it operates in the area of pollution control. Two administrative case studies are extensively examined to reveal insights into the way the administrative process has worked. New water pollution legislation will be examined to consider to what extent it may help the administrative regulation of these problems, and some suggestions of what might be done to achieve the goal and objective of a more responsive and responsible administrative system are offered. (Knapp-USGS)
W70-06844

PROFESSIONALISM AND WATER POLLUTION CONTROL IN GREATER CHICAGO,
Metropolitan Sanitary District of Greater Chicago, Ill.
For primary bibliographic entry see Field 05D.
W70-06871

POTENTIAL IMPACT OF TUNNELS ON WATER POLLUTION AND FLOOD CONTROL IN THE CHICAGO AREA,
Metropolitan Sanitary District of Greater Chicago, Ill.
Forrest C. Neil.
Paper presented at the Annual and Environmental Meeting of the American Society of Civil Engineers, Chicago, October 13-17, 1969. 21 p, 6 fig.

Descriptors: *Underground storage, *Tunnels, *Control structures, *Sewers, *Flood control, *Water pollution control, Water conveyance, Waste water, Shafts, River regulation, Drainage systems, Drainage engineering, Design, Underflow.
Identifiers: *Chicago.

A novel approach to the solution of water pollution and flood control problems in Metropolitan Chicago is described. It is a part of a $2 billion, 10 year approach to meet water quality standards and permit higher uses of the waterways. The present combined-sewer systems cannot handle the tremendous quantities of waste water inputs during periods of precipitation when stormwater runoff is appreciable. Wastes discharged to the canal system, as a result of combined-sewer overflows, are contributing to the pollution of Lake Michigan and the Chicago, Des Plaines, Illinois and Mississippi Rivers. Diversion water from Lake Michigan is presently employed to control pollution of the sanitary canal system. Sewer separation alone would not improve water quality in the waterways sufficiently to meet established standards. A separate sanitary sewer system would cost over 4 billion dollars. Loss of business caused by construction interferences would add considerably to this figure. Therefore a system of deep tunnels for temporary subsurface storage of combined-sewer overflows is desirable. The stored waters will be pumped to the surface, upon cessation of runoff, for normal flow to the treatment plants. This unusual method could be achieved at less than 25 percent of the cost of sewer separation, using rock mole machines. (Poertner-Chicago)
W70-06926

THE ECONOMICS OF WATER QUALITY,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Willian Whipple.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec 1-3, 1965, Urbana, Illinois, 1966, p 225-242, 4 fig, 1 tab, 7 ref.

Descriptors: *Economics, *Water pollution control, *Methodology, Water utilization, *Consumptive use, Withdrawal, Economic justification, Evaluation, Benefits, Supply, Demand, Waste water disposal, Pricing.

Section I discusses the confusion generated by the terms 'consumptive use' and 'withdrawal.' It recommends that water be regarded as used when it receives sufficient effluent wastes to reduce it to minimum acceptable standards. The research necessary to apply this concept statistically is discussed. Section II discusses problems in finding a quantitative measure to justify pollution control economically. The possibility is demonstrated of evaluating economic benefits fairly. Section III postulates the measurement of benefits and formulates the problem of applying supply-demand principles to the disposal flows. Sections IV and V provide an economic analysis of disposal flows. First, the case of simple pollution is considered, so that the economic relationships of a single type of waste can be considered separately. Then, a method is presented to analyze the complex case, where different types of waste have a combined effect on various types of values. Section VI discusses the economic basis for effluent charges and subsidies. A procedure is presented which assures that effluent treatment and stream quality are properly balanced, and that each plant, wherever located, pays the correct cost resulting incrementally from its presence on a stream. (Gossen-Chicago)
W70-06937

THE USE OF URBAN UNDERGROUND SPACE IN STORM WATER MANAGEMENT IN CHICAGO,
Harza Engineering Co., Chicago, Ill.
Richard D. Harza.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 52-55.

Descriptors: *Systems analysis, *Discharge (Water), *Storm runoff, *Water quality control, *Diversion, *Tunneling, Drainage, Land use, Sewage treatment, Electric power production, Population.
Identifiers: *Chicago Deep Tunnel Plan, *Chicago river system, Combined sewers.

The Chicago Deep Tunnel Plan is described from a systems analysis standpoint and a status report of the pilot project Lawrence Avenue 'Underflow Tunnel' is given. Nine existing systems in the Chicago area are discussed and related to the plan. Aspects of the hydrological system and geological and geographical system are mentioned as bringing about the need for lake diversion and creating drainage problems. At the same time, however, the area is highly suitable for tunneling. The human population system introduces needs for fresh water which vary considerably during the day and with increasing living standards. The system of existing land and structural building improvements introduces tremendous costs for land acquistion and distrubance of patterns of commerce and culture. The Chicago river system and the electronic power generating system are mentioned. The sewage treatment facility system and the combined sewer system at present bring problems of unused capacity in the daily 24-hour period and problems of overflow during wet weather. Finally, the system of legal requirements limits diversion and sets water quality standards demanding change in present conditions. The Deep Tunnel Concept is discussed with regard to these systems and two other possibilities of handling storm runoff are outlined: immediate full capacity conveyance and weather control. It is concluded that the Deep Tunnel involving a detention-and-conveyance system with a steep hydraulic gradient and a pump storage plant would be the most effective. (Preckwinkle-Chicago)
W70-06942

HARACTERIZATION AND CONTROL OF VERFLOWS FROM COMBINED SEWERS,
ngineering-Science, Inc., Forest Hills, N.Y.; and ngineering-Science, Inc., Arcadia, Calif.
avid W. Eckhoff, Alan O. Friedland, and Harvey . Ludwig.
roceedings of the Fourth American Water esources Conference (American Water esources Association, Urbana, Illinois, 1968), p 8-84, 5 fig, 5 tab, 5 ref.

escriptors: *Overflow, *Water quality, *Water reatment, *Discharge (Water), *Chlorination, torm runoff, Effluents, Surface runoff.
dentifiers: *Combined sewers, *Dry weather nonitoring, *Wet weather monitoring, *Coliform eterminations, *Dissolved air flotation, *Mass ischarges.

Vith realization of major water pollution problems esulting from combined sewer overflows from rban areas, measures must be developed for conrolling or satisfactorily treatment such discharges, onsistent with the available technological capaility for the protection of beneficial water uses. he objectives of this study in San Francisco were o go beyond previous fragmentary analyses and his involved four unknowns: (1) characterizing ombined sewer overflows for representative urban reas in terms of both quantity and quality; (2) letermining the significance of combined sewer verflows with respect to other urban waste lischarges; (3) evaluating the effects of combined ewer overflows on receiving waters; and (4) assessing feasible control and/or treatment methods or achieving water quality objectives. Description f the study area and of the two pilot sectors is given. Four methods of study are described: dry weather monitoring, wet weather monitoring, receiving water coloform studies, and dissolved air flotation experiments. Results and discussion of these methods plus calculations of mass discharges follows. It is concluded that the treatment of combined sewer overflows is a more feasible alternative to the problem of receiving water pollution than is separation of combined systems. Dissolved air flotation with chlorine disinfection is also concluded to be a promising treatment method for combined sewer overflows. (Preckwinkle-Chicago)
W70-06943

COMPUTER CONTROL OF COMBINED SEWERS,
Minneapolis-St. Paul Sanitary District, Minneapolis, Minn.
James J. Anderson.
Saint Paul, Minn.; Watermation, Inc., October 1969. 19 p, 26 fig, 8 tab, 22 ref. Facilities Demonstration Grant No. 1, Fed. Water Pollution Control Administration, U.S. Dept. of the Interior.

Descriptors: *Automatic control, *Gate control, *Computers, *Regulated flow, *Control systems, *Pollution abatement, *Surface runoff, *Remote sensing, *Telemetry, *Dynamic programming, *Flow control, Sewers.
Identifiers: *Minneapolis-St. Paul Sanitary District, *Combined sewers, *Overflow regulators.

This paper describes a unique application of digital computers for maximizing the capture of urban runoff in the combined-sewer system of the Minneapolis-St. Paul Sanitary District. The real-time dynamic computer control of system overflow-regulators proved effective in helping to increase flows in interceptor sewers, thus reducing the frequency of overflows of raw sewage to the Mississippi River. Major overflow regulators were modified by replacing floats on the gates with hydraulic cylinders. Inflatable dams were installed in trunk-sewer outlets. Level-sensing bubbler tubes with transducers and gate position slidewires were installed to provide sewer level and regulator-status information. Control and telemetry equipment were installed in underground vaults. The data acquisition and control system provides both manual-remote as well as automatic control of the system by central computer using leased telephone wires. The author describes the river monitoring and wastewater sampling methods employed, the rain gage installations, mathematical modeling, and operating methods. He concludes that the feasibility of controlling and operating a large combined-sewer system, using centralized computer control, has been demonstrated and that this data acquisition system will facilitate future testing of improvements in water resource management. (Poertner-Chicago)
W70-06954

IMPROVING THE SOUTHERN ENVIRONMENT,
Tennessee Valley Authority, Knoxville.
Frank E. Smith.
The L.Q.C. Lamar Society and Southwestern at Memphis, Symposium on 'The Emerging South', Memphis, Tennessee, April 18, 1970. Typescript, 18 p.

Descriptors: *Water pollution control, *Air pollution, Abatement, *Quality control.
Identifiers: Tennessee Valley Authority, *Economic development.

The South has not been concerned about the quality of the environment for the South has been preoccupied with attaining an adequate share of the prevailing affluence. Industrial development has lead to pollution, but the desire for greater economic development has allowed the continuing pollution of the South's waters. The South's economic base must expand by continued development of its natural resources. Adequate environmental controls for the Tennessee Valley Authority power generating facilities are discussed. Steps to protect the Southern environment and improve its quality are presented. (Grossman-Rutgers)
W70-06958

ELKINS MINE DRAINAGE POLLUTION CONTROL DEMONSTRATION PROJECT,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
Ronald D. Hill.
Available from the Clearinghouse as PB-191 876, $3.00 in paper copy, $0.65 in microfiche. Paper Presented Before the Third Symposium on Coal Mine Drainage Research, Mellon Institute, Pittsburgh, Pennsylvania, p284-303, May 20, 1970. 14 tab, 5 fig, 4 ref. FWQA Project 14010---04/70.

Descriptors: *Mine drainage, West Virginia, *Acid mine water, Waste water (Pollution), Mine wastes, *Strip mine wastes, Water pollution control, *Revegetation, *Reclamation, Land reclamation.
Identifiers: Elkins (West Virginia).

In 1964, a mine drainage pollution control demonstration project was undertaken near Elkins, West Virginia. The area contained a large drift mine (3,000 acres) which had been extensively surface mined along the outcrop. The objective of the project was to determine the effect on the water quality of 'air' sealing and diverting water away from the underground mine and reclaiming the surface mines. Some 450 subsidence holes were filled, over 12.5 miles of surface mines were reclaimed and 101 seals constructed. Approximately 640 acres of land were disturbed during reclamation which were revegetated in the spring of 1968. This paper reports the effectiveness of the reclamation work for the first two years following construction. The reclamation and revegetation of the surface mines and refuse piles have shown some benefits, however, an equilibrium condition has not been established and the long term effects have yet to be determined. While some areas have shown trends of continued improvement, others showed an improvement the first year, followed by some deterioration the second year. Air sealing, under the conditions at Elkins was unsuccessful, except for one site, the oxygen concentration behind the seal has not decreased and the pollution loads have not decreased. For the combined watershed of Roaring Creek and Grassy Run there has been over a 1,500 ton decrease in the acidity load for the base year 1966. However, none of the streams in either watershed has returned to its unpolluted state.
W70-06965

REAL TIME ROUTING OF FLOOD HYDROGRAPHS IN STORM SEWERS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 07B.
W70-06977

WATER RESOURCES OF IOWA.
Iowa State Geological Survey, Iowa City.
For primary bibliographic entry see Field 06B.
W70-06981

A PILOT STUDY OF STORAGE REQUIREMENTS FOR LOW FLOW AUGMENTATION,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Augustine J. Fredrich.
Paper presented at 49th Annual Meeting of the American Geophysical Union, Washington, D C, April 8, 1968. 16 p, 6 exhibit, 3 ref.

Descriptors: *Systems analysis, *Computer programs, *Low-flow augmentation, *Reservoir design, Optimization, Synthetic hydrology, Reservoir operation, Flow control, Regulation, Waste dilution.
Identifiers: Storage requirements (Water).

By supplementing traditional sequential routing techniques with a relatively simple optimization process and with appropriate generalized physical data it is possible to develop a screening procedure which provides simple application and rapid evaluation of flow augmentation needs and which utilizes most of the available physical data in order to minimize the possibility of an erroneous ranking of alternatives. A pilot study consisted of an analysis of storage requirements for low-flow augmentation to meet pre-established quality demands at 46 locations in the Grand River Basin, Missouri and Iowa. The studies required approximately 8 minutes of computer time on the Control Data Corporation (CDC) 6600 computer. Data preparation for the computer required less than 10 man-hours for the 92 studies. The procedure is flexible enough to consider all available physical and hydrologic data relative to the design and operation of a reservoir project. However, use of the procedure is not limited to areas where a large amount of data is available because analyses may be performed utilizing generated or generalized streamflow data and the simplest reservoir operating rules. (Knapp-USGS)
W70-07029

RECOVERY OF HEAT FROM EFFLUENT (IN FRENCH),
A. Hilliard.
Rayonne et Fibres Synthetiques, Vol 20, No 12, p 1127-1138, 1964.

Descriptors: *Heat exchangers, *Effluents, Water pollution control.
Identifiers: *Waste heat recovery, *Polybloc heat exchanger, *Effluent liquors, Viscose rayon spinning plant, Bleaching bath, Viscose rayon.

The polybloc heat exchanger units are shown to be suitable for effluent liquors. The units are built up from perforated cylindrical metal discs, with polytetrafluoroethylene or graphite seals. Heat recovery units which embody this Polybloc exchanger are described with diagrams: one installation, in which heat from hot washing liquor effluent is used to preheat the bleaching bath in a viscose spinning plant, is described in particular detail. (Livengood and Robinson-North Carolina State Univ)
W70-07036

COLD FACTS ON HOT WATER: LEGAL ASPECTS OF THEMAL POLLUTION,
Larry J. Jost.
Wisconsin Law Review, Vol 1969, No 1, p 253-269, 1969. 17 p, 77 ref.

Descriptors: *Pollution abatement, *Water pollution control, *Cooling water, *Thermal pollution, Heated water, Hydroelectric plants, Nuclear powerplants, Temperature, Steam turbines, Thermal power, Electric power production, Lakes, Rivers, Thermal stratification, Stagnant water, Taste, Water quality, Domestic water, Odor, Public health, Legal aspects, Legislation, Recreation, Fishkill, Oxygen sag, Decomposing organic matter, Cities, Reasonable use, Prior appropriation, Industrial plants, Industrial water.

Thermal pollution and the controls which it requires pose conflicting policy factors. The need for environmental protection must be balanced against the individual's rights. To determine what controls are needed we must determine the source of thermal pollution. The sources are linked principally to the generation of electrical power. Water from rivers and lakes is used to cool the nuclear and conventional generating machinery which in turn raises the temperature of such water. Methods for recooling this water are described. The effect of thermal pollution on water users is discussed. Three areas of water use are emphasized: domestic, industrial, and recreational. Two basic approaches to a legal solution of the problems of thermal pollution are through the rights of private individuals in litigation and through direct governmental action, both state and federal. No federal law exists on thermal pollution, but the existing pollution legislation and administrative agencies are discussed as they affect this problem. Sample state legislation is presented. In conclusion, a strong policy argument is made for the control of thermal pollution. (Barnett-Florida)
W70-07059

RELATIONSHIPS BETWEEN WATER QUALITY AND WATER RIGHTS,
R. B. Robie.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 72-82, 1970. 11 p, 28 ref.

Descriptors: *California, *Water rights, *Water utilization, *Impaired water quality, Riparian rights, Prior appropriation, Groundwater, Water quality, Competing uses, Diversion, Recirculated water, Water reuse, Legal aspects, Judicial decisions, Legislation, Administration, Non-consumptive use, Algae, Evaporation, Reasonable use, Brackish water, Domestic water, Geochemistry, Water cehmistry, Salt balance.

A study of the interrelationships of water quality to water rights involves many legal aspects--riparian, appropriative and prescriptive rights, rights to the use of groundwater and reuse of water. Every exercise of a water right has some effect on water quality. The return flow of diverted waters may contain a higher concentration of minerals and salt than previously. The reduced flow caused by diversion may have several results including: (1) a reduction in the assimilative capacity of a stream; (2) larger evaporation losses; (3) increased stratifications; (4) accelerated algae growths; and (5) saline intrusion. Courts have long recognized water quality as a water right. Downstream riparian owners, for example, have been able to enjoin the irrigation use of an upstream riparian owner. Junior appropriators have been held liable for pollution that interferes with the rights of a senior appropriator. It is possible that the right to degrade water could be apportioned among users. A uniform approach is necessary however. Various statutory laws, case decisions, and administrative rules and regulations affecting the subject are discussed, especially as relates to California. (See also W70-07095). (Marsee-Florida)
W70-07100

REGIONAL WATER QUALITY MANAGEMENT AND CONTROL,
For primary bibliographic entry see Field 06E.
W70-07101

A REVIEW OF THE TEXAS WATER PLAN: ISSUES AND ATTITUDES,
For primary bibliographic entry see Field 06E.
W70-07104

SEADADE INDUSTRIES, INC V FLORIDA POWER AND LIGHT CO (CONDEMNATION OF LAND TO BUILD CANAL FOR COOLING OF WATER FROM NUCLEAR POWER PLANT).
232 So 2d 46-53 (3rd DCA Fla 1970).

Descriptors: *Florida, *Nuclear powerplants, *Canals, *Condemnation, Eminent domain, Public utilities, Legal aspects, Legislation, Public rights, Economics, Land tenure, Land use, Cooling, Engineering structures, Ecology, Thermal pollution, Environmental effects, Judicial decisions, Water pollution, Condemnation value, Economic impact, Bodies of water, Canal construction, Heated water.

Florida Power and Light Company sought to condemn plaintiff's land to build a canal for cooling heated water from defendant's nuclear powerplant. Plaintiff claimed that no necessity for the taking had been shown, and that the powers of condemnation had been abused. The court found that the defendant had reasonably concluded, taking into account economic and other factors, that such a canal was necessary to cool the water from the plant. It was held that defendant could not take a portion of the property for storage of the material excavated from the canal. The fact that the defendant Power Company had not obtained prior approval to discharge heated water into the sound was held no obstacle to its condemnation of the land in question. The court specifically refrained from ruling on legal aspects of discharging heated water into a nearby sound. (Caldwell-Florida)
W70-07106

SATREN V HADER COOPERATIVE CHEESE FACTORY (PRESCRIPTIVE RIGHT TO POLLUTE).
279 NW 361-364 (Minn 1938).

Descriptors: *Minnesota, *Prescriptive rights, *Water pollution, *Pollution abatement, Boundaries (Property), Industries, Judicial decisions, Land tenure, Legal aspects, Proprietary power, Relative rights, Riparian lands, Riparian rights, Usufructuary right, Water rights, Disposal, Imaired water quality, Water pollution effects, Odor, Turbidity, Remedies, Reasonable use.

Defendant cheese factory discharged large amounts of whey into a stream which flowed through plaintiff's land. The whey caused a putrid odor to emanate from the stream and increased the turbidity of the water. When the cheese factory had initially begun operation, the amount of whey discharged into the stream had been so insignificant as to have no adverse effect on the water. As the operation grew, the pollution increased to the point where plaintiff brought suit for an injunction and damages. Defendant claimed that it had obtained a prescriptive right to pollute the stream and in any event that injunctive relief was not warranted since it would force defendant out of operation. The court held that a prescriptive right to maintain a nuisance cannot arise unless the nuisance has continued in substantially the same way and with equally injurious results for the entire statutory period. The evidence showed that the nuisance was not uniform in character or result. The court further held that a riparian owner may make, for business purposes, only a reasonable use of a stream flowing through his land. The extent to which defendant polluted the stream in question was held not reasonable. In such a case, injunctive relief was a proper remedy. (Clarke-Florida)
W70-07125

STATE EX REL MARTIN V CITY OF JUNEAU (MUNICIPAL POLLUTION).
300 NW 187-191 (Wis 1941).

Descriptors: *Wisconsin, *Local governments, *Pollution abatement, *Water pollution, Abatement, Human population, Judicial decisions, Legal aspects, Legislation, Public benefits, Public right, Public health, State governments, State jurisdiction, Impaired water quality, Water pollution effects, Administrative decisions, Water pollution control, Water quality, Sewage, Water quality control, Administrative agencies, Cities, Municipal wastes, Effluents.

Defendant city was discharging into a drainage ditch sewage effluent which did not meet the minimun standards of public health and safety established by the State Board of Health and the State Committee on Water Pollution. A joint order was issued by the agencies commanding the city to install an adequate sewage treatment system within a specified period of time. The order was not complied with. The Attorney General sought a mandatory injunction to force compliance with the order and cessation of discharge of inadequately treated sewage. Defendant contended that the order was indefinite and in excess of the powers conferred by statute on the State Board and State Commission. The court held that the authority of the state legislature is supreme over that of a municipal corporation and that the promotion of public health is clearly a matter of state-wide concern. The Wisconsin statute giving the Committee and the State Board authority to promote public health clearly included regulation of water pollution. It also provided for administrative review procedures which defendant had not attempted to utilize. The joint order issued by the State Board and the Committee was not in excess of their statutory authority. Even if it was, however, defendant had not exhausted its administrative remedies. (Clarke-Florida)
W70-07129

AMERICAN BRASS CO V WISCONSIN STATE BOARD OF HEALTH (JOINT ORDER BY SEPARATE STATE AGENCIES: POLLUTION).
15 NW2d 27-32 (Wis 1942).

Descriptors: *Wisconsin, *Administrative agencies, *Pollution abatement, *Institutional constraints, Legislation, Sewage treatment, Treatment facilities, Sewage disposal, Public health, Water pollution, Surface waters, Water pollution control, Water quality control, Judicial decisions, Legal aspects, State governments, Coordination, Water policy, Industrial wastes, Remedies, Effluents, Administration, Political constraints.

Defendants, the State Board of Health and the State Committee on Water Pollution, issued a joint order to the plaintiff company relating to pollution of surface waters and requiring submission of plans for pollution abatement. Plaintiff appealed the order. The court found that the two agencies were completely separate, were set up by different statutes, and possessed separate areas of responsibility. The court held that there was no statutory foundation for such joint action and that the order was null and void. The fact that the powers of the agencies were complementary, the Board of Health dealing with sewage disposal from the standpoint of public health, and the Committe dealing with Pollution of surface waters, was found not to justify the order in the absence of express statutory authority. (Caldwell-Florida)
W70-07130

JESSUP AND MOORE PAPER CO V ZEITLER (INDUSTRIAL POLLUTION OF STREAM--LOWER RIPARIAN RIGHTS).
24 A2d 788-792 (Md 1942).

Descriptors: *Maryland, *Riparian rights, *Beneficial use, *Pollution abatement, Streams, Rivers, Industrial wastes, Chemical wastes, Water pollution sources, Judicial decisions, Relative rights, Natural

flow, Mills, Water quality, Reasonable use, Water utilization, Pulp wastes, Stream pollution, Remedies.
Identifiers: Injunction (Prohibitory).

Three lower riparian owners sought an injunction against pollution of a stream by paper companies. Defendants demurred to the bill. The trial court overruled the demurrer. In affirming, the appellate court stated that every riparian owner is bound to use a stream so as not to interfere with beneficial enjoyment by other riparian owners. A riparian owner has a right to the enjoyment of a stream in its natural flow, quantity, and quality. The lower riparian owners could join in one action two or more wrongdoers polluting a stream even though they were acting independently of each other in causing the injury. (Hubener-Florida)
W70-07134

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

A STEADY STATE OPTIMAL DESIGN OF ARTIFICIAL INDUCED AERATION IN POLLUTED STREAMS BY THE USE OF PONTRYAGIN'S MINIMUM PRINCIPLE,
Rutgers - The State Univ., New Brunswick, N.J.; and Electronic Associates, Inc., Princeton, N.J.
For primary bibliographic entry see Field 05F.
W70-06743

THE INTEGRATED USE OF GROUND AND SURFACE WATER IN IRRIGATION PROJECT PLANNING,
Harvard Univ., Cambridge, Mass. Center for Population Studies.
For primary bibliographic entry see Field 03F.
W70-06837

THE KINEMATIC CASCADE AS A HYDROLOGIC MODEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-06843

COMPUTER AIDED DESIGN OF WASTE COLLECTION AND TREATMENT SYSTEMS,
Michigan Univ., Ann Arbor.
Rolf A. Deininger.
In: Proceedings of the Second Annual American Water Resources Conference, American Water Resources Association, Urbana, Ill., 1966. p 247-258.

Descriptors: *Waste treatment, *Wastes, *Digital computers, *Optimization, Sewers, Topography, Flow, Costs, Regions, Linear programming.
Identifiers: *Waste collection, *Automatic design, Trunk sewers, Regional treatment, Nonlinear programming, Automatic plotting, Time-sharing computer systems.

This paper describes and summarizes research which has been carried out at the University of Michigan in an effort to define the feasibility and limitations of the use of digital computers in the automatic design of waste collection and treatment systems. Several separate topics were investigated. The first one deals with the optimal design of a trunk sewer. Given information about the topography, flows, costs of pipe and excavation, the problem of determining a minimum cost trunk sewer is cast as a non-linear programming problem, which by suitable approximations, can be restated as a linear programming problem. The second area of research is concerned with the problem of regional treatment systems. The decrease in per capita costs with increasing size of plant or sewer system is known and the mathematical programming problem is one of simultaneously minimizing the cost of waste collection and waste treatment. The problem is shown to be of the form of a general network problem. Approaches for a solution are indicated. The third area of research is concerned with the design of a treatment plant in conversational form on a time-share computer system and the use of automatic plotting equipment for generating construction plans of treatment plants. (Richmond-Chicago)
W70-06849

EFFICIENT MANAGEMENT POLICIES FOR URBAN WATER SUPPLY,
Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
David J. Allee.
Remarks at the Spring 1970 Conference, 'Water in an Urban Environment' sponsored by the American Society of Engineers at Catholic University, Washington, D.C., 31 March 1970. Typescript, 17 p.

Descriptors: *Economic efficiency, *Management, *Administration, *Inter-agency cooperation, Efficiencies, Water supply, Costs, Benefits, Economics, Political aspects, Political constraints, Institutional constraints, Welfare (Economics).
Identifiers: *Management policies, *Urban water supply, *Cost-sharing.

An attempt is made to spell out the difficult conditions faced by urban water supply managers in the past as they have attempted to achieve overall efficiency. Based upon this discussion, strategies formulated by a blending of economic and political concepts are suggested which could lead to higher levels of social efficiency in the future. Efficiency of an urban water supply is defined from a welfare economics viewpoint: It would be a water supply system where no change in delivery capacity or usage pattern can be made where the total value of the gain, or the benefits, caused by the change exceed the value of the corresponding losses or costs. The various assumptions necessary to this definition are discussed as well as the two factors which summarize the difference between this hypothetical statement and reality. First, responsibility for water supply has tended to have been delegated to special agencies. Second, there is a tendency toward geographic and institutional fragmentation of political constituencies. Several possible federal strategies are suggested: (a) sharing the burden of planning and development with local agencies, (b) inter-agency cooperation at the federal level, (c) more effective use of federal funds, and (d) a direct federal role in the actual operation of a regional agency. (Davis-Chicago)
W70-06929

THE ECONOMIC IMPACT OF DROUGHT ON WATER SUPPLY SYSTEMS IN THE PASSAIC RIVER BASIN, NEW JERSEY,
New Jersey Agricultural Experiment Station, New Brunswick.
For primary bibliographic entry see Field 05D.
W70-06960

OPTIMUM DESIGN OF COMPLEX WATER RESOURCE PROJECTS,
Rand Water Board, Johannesburg (South Africa).
David Stephenson.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY6, Paper 7320, p 1229-1246, June 1970. 18 p, 6 fig, 3 tab, 5 ref, append.

Descriptors: *Reservoir design, *Optimization, *Frequency analysis, *Draft-storage curves, *Linear programming, Reservoir storage, Water resources development, Operations research, Systems analysis, Mathematical models.
Identifiers: South Africa.

Permissible draft from reservoirs is related to reservoir capacity by draft-storage-frequency analysis and the resulting draft-storage curves are expressed in algebraic form suitable for the optimum design of the reservoir system by linear programming. The curves are general and can apply to a number of reservoirs together. The principle of decomposition of linear programs is used to divide complex systems into projects, at the same time considering interbasin links. The river basins are then optimized using operations research techniques on individual basins or projects. A mathematical model of the Vaal and Tugela river basins in South Africa is used as an example. (Knapp-USGS)
W70-06980

SYNTHESIS OF URBAN RAINFALL,
Auckland Univ. (New Zealand).
A. J. Raudkivi, and N. Lawgun.
Water Resources Research, Vol 6, No 2, p 455-464, April 1970. 10 p, 4 fig, 7 tab, 3 ref.

Descriptors: *Statistical models, *Computer models, *Synthetic hydrology, *Simulated rainfall, *Depth-area-duration analysis, Statistical methods, Time series analysis, Mathematical models, Correlation analysis, Markov processes, Stochastic processes, Rainfall, Precipitation (Atmospheric), Cities, Urbanization.
Identifiers: Urban rainfall.

A statistical analysis of rainfall records is used to develop a computer model for generation of a sequence of short period rainfalls. The time intervals between rainfalls are generated by sampling from a frequency distribution fitted to the historical data. The model also uses a first order Markov process in addition to random sampling from a frequency distribution, to obtain the rainfall durations. Rainfall depths are obtained by sampling from the joint distribution of rainfall depths and durations. Model parameters are based on the meteorologic conditions of the Auckland area, and all statistical tests were performed at a 5% level of significance. The model produces comparable time intervals between storms and a linear correlation between rainfall depths and durations, but extreme values of rainfall depths and durations are absent from the generated data. (Knapp-USGS)
W70-06992

A FACTOR ANALYSIS OF RESERVOIR LOSSES,
Agricultural Research Service, Riesel, Tex. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 04A.
W70-06997

RECURRENCE INTERVALS BETWEEN EXCEEDANCES OF SELECTED RIVER LEVELS 3. ESTIMATION AND USE OF A PRIOR DISTRIBUTION,
New South Wales Univ., Kensington (Australia). Dept. of Statistics; and Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
For primary bibliographic entry see Field 02E.
W70-06998

STATISTICAL ASPECT OF THE PROBLEM OF PERMEABILITY OF FISSURED ROCKS,
For primary bibliographic entry see Field 02F.
W70-07088

6B. Evaluation Process

A METHOD TO ANALYZE THE EFFECTS OF FLUCTUATION RESERVOIR WATER LEVELS ON SHORELINE RECREATION USE,
Waterloo Univ. (Ontario). School of Urban and Regional Planning.
Reiner Jaakson.
Water Resources Research, Vol 6, No 2, p 421-429, April 1970. 9 p, 3 fig, 3 tab, 1 ref.

Descriptors: *Reservoirs, *Water level fluctuations, *Recreation, Costs, Multiple-purpose reservoirs, Flood control, Planning, Water management (Applied), Reservoir operation, Reservoir design, Economics, Cost-benefit analysis.
Identifiers: Shoreline recreation.

A direct relationship exists between reservoir water level fluctuations and shoreline recreational quality. An increasing acknowledgment that recreation is one of the more active basic economic factors of regional growth has helped to justify the maintenance of constant, or near constant, levels during the recreation season. A methodology is presented whereby the optimum water level for a reservoir can be identified, based on an analysis of recreation potential of the shoreline at different lake levels. Applications of the methodology also assess shoreline damages due to flood levels. A shoreline inventory taken before a major flood may be compared to an inventory taken after the flood; differences in physiographic rates illustrate the loss of shorline use due to erosion, to loss of tree cover, and to change of beach materials. Further uses of the methodology include economic comparisons of the value of maintaining constant lake levels with the value of maintaining flood storage levels. Dollar values attached to shoreline rates provide an estimate of the loss of shoreline use due to flood storage levels, which may be compared with the benefit of flood prevention in the floodplain of an adjoining river basin. (Knapp-USGS)
W70-06742

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOLUME II, APPENDIX.
Federal Water Pollution Control Administration, Washington, D.C.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $4.75. FWPCA Report, Jan. 10, 1969. 541 p, 1 map.

Descriptors: *Economic impact, *Water costs, Investment, Interest rate, Replacement costs, Sewerage treatment, Depreciation, Operating costs, Maintenance costs, Industrial wastes, Thermal pollution, Pesticide residues, Soil contamination.
Identifiers: *Federal Water Pollution Control Act.

This is the appendix to Vol. 1, of the Report series. The appendix contains summary tables on the United States, tables of each state, major basin tables, state agency comments, and industrial organization comments. The tables cover the following areas: (1) 1962 municipal waste inventory, (2) contract awards 1962-1967, (3) 1968 municipal waste inventory; (4) ratio of design loading to domestic loading, (5) ratio of indicated loading to domestic loading; (6) joint treatment facilities; and (7) implementation plans summary. A glossery of terms is included. (See also W70-06840) (Grossman-Rutgers)
W70-06839

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOLUME III, (SEWERAGE CHARGES).
Federal Water Pollution Control Administration, Washington, D.C.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $1.75. FWPCA Report, Jan. 10, 1969. 103 p, 19 tab, 64 ref.

Descriptors: *Economic impact, *Water costs, Investment, Interest rate, Replacement costs, Sewerage treatment, Depreciation, Operating costs, Maintenance costs, Industrial wastes, Thermal pollution, Pesticide residues, Soil contamination.
Identifiers: *Federal Water Pollution Control Act.

This volume covers the current position of user charges, types of user charges, division of cost responsibility between users and nonusers, allocation theories, and the distribution of cost responsibility among categories of users. An appendix of sewerage charges in each state is included. (See also W70-06841) (Grossman-Rutgers)
W70-06840

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOL. IV. PROJECTED WASTE WATER TREATMENT COSTS IN THE ORGANIC CHEMICALS INDUSTRY.
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $1.75. FWPCA Report, June 1968. 191 p, 28 tab, 45 fig, 4 append, 73 ref.

Descriptors: *Pollution abatement, *Waste water treatment, *Costs, Chemical wastes, Treatment facilities.
Identifiers: *Organic chemical industry.

An estimate of the costs that would be incurred by the organic chemicals industry in attaining various levels of pollution abatement over a five-year period is presented. Also included is a generalized methodology by which similar continuing estimates can be made for other water-using industries. Cost estimates are derived from published data, general data derived from information in the files of the author, companies on industrial waste treatment and costs, and specific data from 54 organic chemical plants. The total costs given in this report are for the construction and operation of waste treatment facilities for the industry as a whole. Projections as to various aspects of the organic chemicals industry are estimated for 1969 and projected for 1973 are included. The appendices contain the data form utilized in the study, survey data, petrochemical industry product profiles, and costs of unit waste water treatment practices. (See also W70-06838) (Grossman-Rutgers)
W70-06841

WATER AND ESTHETICS IN THE LOWER COLORADO RIVER BASIN,
Sierra Club, San Francisco, Calif.
David R. Brower.
In: Proceedings of the Second Annual American Water Resources Conference, American Water Resources Association, 1966, p. 134-142, 32 ref.

Descriptors: *Reclamation, *Conservation, *Political aspects, Water supply, Water transfer, Economics, Silt.
Identifiers: *Grand Canyon, *Grand Canyon National Park, *Grand Canyon National Monument, *Bureau of Reclamation, *Sierra Club, *National Reclamation Association, *Reclamationist, *Conservationist, *Special-interest groups, *Esthetics.

As a member of the Sierra Club, the author pleads for the protection of the Grand Canyon National Park and National Monument which is threatened by the National Reclamation Association and Bureau of Reclamation's proposal to build a series of dams in the canyon. He deals with the matter of water supply by illustrating the area's inefficient use of water. He argues that the Hoover Dam is a more efficient supplier of cash reserves than the proposed dams. He debates the claim that the new revenues provided are needed to finance the importation of water, noting that this far off plan may not come to fruition. In answer to the claim that the Grand Canyon would be enhanced and not flooded out, he argues that 148 miles of living river would be destroyed and that 105 miles of canyon would be made inaccessible. He supports alternate financing of water development, citing TVA support of nuclear power plants in that coal rich area. The reclamationist proposal claimed that such an arrangement was nonsense. He debates the reclamationist claim of preparing for the future water uses by disagreeing that such a need will actually develop. He makes a plea for public support, pointing out that once this land is lost to reclamation, it cannot be recovered. (Richmond-Chicago)
W70-06847

THE INCREASING IMPACT OF RECREATION ON WATER RESOURCES PLANNING,
California State Dept. of Water Resources.
Reginald C. Price.
In: Proceedings of the Second Annual American Water Resources Conference, American Water Resources Assn., Urbana, Ill., 1966. p 187-92.

Descriptors: *Recreation demand, *Recreation, *Recreation ficilities, *Multiple-purpose reservoirs, *Financing, *California, *Planning, *Water resources development, *Social values, *Evaluation, *Interagency cooperation, Water pollution effects, *Urbanization, Benefits, Economic impact, Boating, Fishing, Camping, Hunting, Swimming, Wildlife.
Identifiers: *Leisure, *Trice-Wood method, *Intergovernmental cooperation, *Comprehensive planning, Recreational opportunities.

The author emphasizes the tremendous growth of water-oriented recreation. This growth is seen as a result of increased leisure time and personal income combined with the desire to escape from urban areas for some part of the year. To meet these needs, which will continue to increase at an even greater rate in the next 50 years, multiple-purpose water resources projects must be designed. In addition, older projects which did not consider recreational benefits must be altered to help meet the recreation demand. As such, recreation has had a tremendous impact on planning. New methods of project evaluation such as California's Water Resources Department's Trice-Wood method have been developed in response. More sophisticated approaches, as suggested in Senate Document No. 97 are now being developed. In addition, cooperation between and within, Federal, state and local governments is also necessary if a coordinated comprehensive water resources planning approach is to be achieved. The Federal Water Recreation Act (1965) is seen as a step toward such an achievement. A short case history of the Auburn-Folsum South Unit of the Central Valley Project of California is included. (Richmond-Chicago)
W70-06850

TRENDS IN SMALL BOATING AND ITS IMPACT ON WATER RESOURCES DEVELOPMENT,
Boating Industry Association.
Fred B. Lifton.
In: Proceedings of the Second American Water Resources Conference, American Water Resources Assn., Urbana, Ill., 1966. p 182-86.

Descriptors: *Boating, *Recreation, *Recreation demand, *Recreation facilities, Water pollution effects, *Water pollution control, *Water pollution, *Financing, *Economic impact, *Economics, Reclamation, Multiple-purpose reservoir, Channel improvement, Locks, Federal government, State governments, Local governments.
Identifiers: *Research needs, *Unfunded gasoline taxes, *Federal Land and Water Conservation Act, Fun and sun-seeking enthusiast.

The author is a spokesman for the manufacturers of recreational boating materials. He points out the nation's growing interest and participation in water recreation activities. The need for more facilities near metropolitan population centers is discussed. It is suggested that such needs could be met by enforcing strict pollution control measures on polluters, thereby reclaiming waterways and lakes in urban areas. At the same time, the water would have to be cleaned, channels dredged and some locks and dams constructed. The author suggests that these tasks could be financed from the unrefunded gasoline taxes which presently amount to $100 million. He cites the passage of the Federal Land and Water Conservation Fund Act (1964) as

step in the right direction, even though much of ne monies spent do not go to water-oriented ecreation. Finally, he states that governmental upport cannot be justified by recreational needs lone. To this end he points out that many areas ave undergone economic rejuvenation as a result f flood control and power projects. Research to ocument the nature and magnitude of these enefits is called for with the suggestion that the ederal government do the actual research. Richmond-Chicago)
W70-06851

DEVELOPMENT BENEFITS OF WATER RESOURCES INVESTMENTS.
Washington Univ., St. Louis, Mo.

Charles L. Leven, Editor. Corps of Engineers, Institute for Water Resources. Report IWR 69-1, Alexandria, Virginia, Nov. 1969, 443 p, 7 fig, 97 ab, 133 ref. Contract Number DA 49-129-CIVENG-66-11.

Descriptors: *Indirect benefits, *Methodology, Economics, Regional analysis, Theoretical analysis, Data processing, Analytical techniques, Model studies, Federal project policy.

The project focuses on the question of determination and evaluation of developmental benefits of water resource investments. It recognizes that, in addition to the value of water resource services to service users (primary benefits), water resource investments might enhance a region's economy (secondary benefits). The central problem of the project is to evaluate the national and interregional consequences of exogenous change in a single region. Solution of that problem requires new theoretical formulations, new analytical techniques, and unconventional kinds and combinations of data. Analysis of primary benefits remains unchanged. This report provides some of the needed reformulations in regional development theory and develops practical operational analyses. It recommends particular revisions in present Corps evaluation procedures. The report consists of four sections: (1) overview of the project; (2) development of theory; (3) descriptions of analytical models; and (4) description of purposes and present evaluation procedures, with some suggestions for alterations. Each section includes two or more chapters. (See also W70-06854 thru W70-06861) (Gossen-Chicago)
W70-06853

CHAPTER 1: THE PROBLEM.
Washington Univ., St. Louis, Mo.

In: Development Benefits of Water Resources Investments. U.S. Army Institute for Water Resources, Alexandria, Virginia, Nov., 1969, p. 1-17, 1 fig.

Descriptors: *Indirect benefits, *Methodology, *Economics, Regional analysis, National income, Evaluation, Cost-benefit analysis, Direct benefits, Human population, Water supply, Administrative agencies.

Chapter 1 discusses: the nature of the problem of determining developmental, or secondary benefits; the methodology developed to solve this problem; and why the chosen methodology was adopted. Developmental effects are triggered by any of three kinds of reactions to water resource investments: (1) when economic activities which might not otherwise occur in the area, locate there in response to the enhancement of its water resources; (2) when non-residents come to the area for recreation; (3) when individuals move to the area because of its water resources development. Any of these developments in one area necessarily has consequences for economic activity levels in other areas. These consequences and over-all effects on the national economy must be determined. The first difficulty in this determination is that developmental effects cannot be thought of as a number. The second complication is that the distribution of effects by region depends on the way regions are defined. The analyses developed in this study are useful to primary benefit evaluation in two ways: (1) by computing regional distribution of population as an independent variable; and (2) by recognizing that water availability affects population. Organizational implications for the Corps are discussed. (See also W70-06853) (Gossen-Chicago)
W70-06854

CHAPTER 2: APPROACHES TO A SOLUTION.
Washington Univ., St. Louis, Mo.

In: Development Benefits of Water Resources Investments. U.S. Army Institute for Water Resources, Alexandria, Virginia, Nov., 1969, p. 18-46, 1 fig.

Descriptors: *Methodology, Indirect benefits, Regional analysis, Water costs, Water quality, Water supply, Employment, Recreation facilities, Economic impact, Construction costs, Navigation, Input-output analysis, Model studies, Taxes, Transportation.
Identifiers: General equilibrium effects, Agglomeration effects.

Chapter 2 discusses two stages of analysis in determining developmental effects. The first stage, developed by the University of Chicago, includes changes in cost, quality, and availability of water resource services explicitly as independent variables. It determines the following relationships: (1) employment and output as a function of the cost, quality, or availability of water; (2) utilization of recreation facilities as a function of their scale and characteristics; (3) volume of economic activities involved in constructing water resource projects as a function of their scale and characteristics; and (4) cost of water transportation as a function of navigational properties of waterways. The second stage, developed by Washington University, determines general equilibrium effects. The approach used is a conventional regional input-output analysis, extended by making calculations to a fuel interregional interindustry format and by adding models to: (1) determine agglomeration effects; (2) estimate the impact of interregional changes in activity on state tax avenues; and (3) estimate consequences of regional reallocations of economic activities for the use of transport inputs. The scope, form, and necessary limitations of both stages of analysis are discussed. Complications inherent in the first stage are analyzed. (See also W70-06853) (Gossen-Chicago)
W70-06855

CHAPTER 3: A MODEL OF DIFFERENTIAL REGIONAL GROWTH.
Washington Univ., St. Louis, Mo.

In: Development Benefits of Water Resources Investments. U. S. Army Institute for Water Resources, Alexandria, Virginia, Nov., 1969, p 47-66, 7 ref.

Descriptors: *Mathematical models, *Methodology, *Economic prediction, Human population, Employment, Labor supply, Labor mobility, Capital supply, Regional analysis, Migration, Wages.
Identifiers: Export-base theory of forecasting, Borts-Stein theory, Export demand.

Chapter 3 discusses the problem of predicting future population and employment. Section I discussed past theories of forecasting. Most theories are based on the export-base theory. Borts and Stein, however, suggest: (1) that differential changes in manufacturing employment result from differential shifts in labor supply to a region's manufacturing sector; and (2) that the demand for a region's exports and its supply of capital are infinitely elastic. Section II demonstrates the appropriateness of the Borts-Stein theory to a developmental situation. Sections III and IV, the major sections of the chapter, describe the model and formulate it mathematically. The model determines employment change and migration simultaneously. The dependence of migration on the change in employment has two causes: (1) firms wishing to expand employment in a particular community may transfer workers from other places; and (2) migrants may be attracted to areas where employment is growing relative to the labor force. Differential changes in wage rates, and effects on total regional employment of changes in exportable sector demand and in labor supply are determined by the Borts-Stein approach. Section IV formulates the model as a system of eight simultaneous structural equations in eight endogenous variables. (See also W70-06853) (Gossen-Chicago)
W70-06856

CHAPTER 4: THE REGIONAL GROWTH MODEL AND EMPIRICAL ANALYSIS.
Washington Univ., St. Louis, Mo.

In: Development Benefits of Water Resources Investments. U.S. Army Institute for Water Resources, Alexandria, Virginia, Nov., 1969, p. 67-106, 5 tab, 17 ref.

Descriptors: *Methodology, *Mathematical models, Data processing, Statistical models, Economic prediction, Employment, Migration, Wages.
Identifiers: *Empirical testing.

Chapter 4 subjects the regional growth model to empirical analysis, using twenty-five cities for test studies. Section I describes the nature of the data used as empirical measures of the model's variables, the time period and areal units for which these measures were obtained, and discusses the selection of predetermined variables. Using this data, Section II discusses the model's estimates of the employment change and migration equations. Section III discusses the estimates of the model's other equations. These two sections focus on the statistical features of the estimates. Section IV considers some of their economic implications. The empirical results support the hypothesis that money wage rates are exogenously determined by firms selling their outputs and buying non-labor inputs in national markets. Results cast doubt on the hypothesis that employment change is exogenously determined and that wage rigidities or other labor market imperfections limit the availability of jobs. It appears that migration is not importantly affected by firms transferring or hiring workers in other places. (See also W70-06853) (Gossen-Chicago)
W70-06857

CHAPTER 7: SOME APPLICATIONS.
Washington Univ., St. Louis, Mo.

In: Development Benefits of Water Resources Investments. U.S. Army Institute for Water Resources, Alexandria, Virginia, Nov., 1969, Contract Number DA 49-129-CIVENG-66-11, p. 217-280, 26 tab.

Descriptors: *Mathematical models, *Methodology, *Economic prediction, Regional analysis, Employment, Recreation, Industries.
Identifiers: *Youghiogheny Reservoir Area.

Chapter 7 discusses model-derived results for a prospective project in the Youghiogheny Reservoir Area (YA) and describes how they were obtained. The analysis depends on interregional location and interregional impact models developed in previous chapters and on results from a separate University of Chicago study. Estimates are derived: (1) of the impact of the project on employment in each of the five major water-using industries in YA; and (2) of additional user-days of recreation in YA resulting from the project. Section I transforms projections of employment estimates for water-using industries into a form suitable for estimating interregional-inter-industry impacts. The process is mainly application of an interregional location model. Section

II outlines the computation procedure. Section III describes the modifications and format needed to fit the recreation-use estimates into the interregional-interindustry model. The final section discusses the interregional-interindustry calculations and presents the results of those calculations. For 23 industries in 3 regions, changes are shown in activity levels of water-using industries, of recreation-oriented activity, and of both combined. (See also W70-06853) (Gossen-Chicago)
W70-06858

CHAPTER 9: OBJECTIVES AND PRESENT PRACTICES IN EVALUATION OF WATER RESOURCE PROJECTS.
Washington Univ., St. Louis, Mo.

In: Development Benefits of Water Resources Investments. U.S. Army Institute for Water Resources, Alexandria, Virginia, Nov., 1969, p. 324-370, 40 ref.

Descriptors: *Economic justification, *Federal project policy, History, Water resources, Planning Act, Project planning, Water quality control, Erosion control, Flood control, Recreation, Benefits, Costs, Cost-benefit ratio.
Identifiers: Senate Document 97, Congressional project selection, Water supply control.

Deriving an optimum investment policy would require exact welfare function specification. Pursuing such an objective function is beyond the scope of the study, but a formal statement of evaluation procedures is provided in Chapter 9, along with a description of policy objectives. Section I considers the scope and objectives of federal water resource policy over time. Sections II and III analyze Senate Document 97 and the Water Resources Development and Planning Act. Together these two documents represent the current federal water resources policy. Section IV examines the Congressional record of project selection. Section V initiates an attempt by succeeding sections to summarize the most important elements of present practices in economic evaluation on the basis of policy statements, technical manuals and selected project reports. Section VI discusses four categories of water resources control: (1) water supply and quality control; (2) prevention of soil erosion; (3) flood control; and (4) recreation uses. Section VII describes general principles of project formulation. Sections VIII and IX evaluate benefits and costs. Section X comments on integrating projects with plans and on the economic bias of excess benefits. (See also W70-06853) (Gossen-Chicago)
W70-06859

CHAPTER 10: SOME ISSUES IN PRESENT PRACTICES OF PROJECT EVALUATION.
Washington Univ., St. Louis, Mo.

In: Development Benefits of Water Resources Investments. U.S. Army Institute for Water Resources, Alexandria, Virginia, Nov., 1969, p. 371-443, 2 fig, 19 tab, 28 ref.

Descriptors: *Federal project policy, Investment, Cost-benefit ratio, Interest rate, Evaluation, Costs, Benefits, Theoretical analysis, Appropriation.
Identifiers: Internal rate of return, Social costs, Distribution of benefits.

Three issues are discussed: (1) should federal projects be selected on the basis of maximum benefit-cost ratio or internal rate of return on invested funds; (2) at what rate of interest are future benefits discounted to the present; and (3) according to what principles are costs and benefits actually evaluated. Section I shows that benefit-cost analysis is ordinarily the preferred criterion for public investment and that it is a feasible alternative to the rate of return criteria. The theoretical superiority of benefit-cost analysis is proven. However, for benefit-cost analysis to be used, an interest rate must be found which is stable and which accurately reflects the social cost of capital. Section II argues that such an interest rate can be established. Section III analyzes present evaluation practices of the Corps of Engineers, and shows that distributional effects are inadequately considered. The final section suggests two methods of accounting for distributional effects, and recommends that the Legislature announce to the Corps what distributional weights it wishes the Corps to assign. This action would explicate the value system implicit in the appropriation process, thereby reducing the uncertainty of the sequence in which projects will be funded. (See also W70-06853) (Gossen-Chicago)
W70-06860

DEVELOPMENT BENEFITS OF WATER RESOURCES INVESTMENTS (APPENDICIES).
Washington Univ., St. Louis, Mo.

Charles L. Leven (editor). Corps of Engineers, Institute for Water Resources Report IWR 69-1, Alexandria, Virginia, November, 1969, 310 p. Contract No. DA 49-129-CIVENG-66-11.

Descriptors: *Indirect benefits, *Methodology, Economics, Regional analysis, Theoretical analysis, Data processing, Analytical techniques, Model studies, Federal project policy.

Contents: Appendix A, The Efficacy of Labor Migration with Special Emphasis on Depressed Areas; Appendix B, The Influence of Community Characteristics on the Relationship of Unemployment Changes to Employment Changes in Major Labor Market Areas; Appendix C, Programs for Computerized Location Models for Assessing Regional Shifts in Industrial Location; Appendix D, Economic Base and Input-Output Models and Their Role in Regional Analysis; Appendix E, Mathematical Derivation of the Interregional Input-Output Model; Appendix F, Area Definition; Appendix G, Industrial Definition; Appendix H, Wholesale Sector Survey; Appendix I, Combination Transforms for the Aggregation of Interregional Commodity Flows; Appendix J, Interindustry Analysis Tables for Appalachia, Ozarka and Rest of the United States; Appendix K, Regional System B; Appendix L, Regional System C; Appendix M, Outputs of Computerized Location Model; Appendix N, Users of Youghiogheny Recreation Facilities by State and County of Residence; Appendix O, Programming Statement for Pilot Area Impact Solutions; Appendix P, Testing for Constancy Over Time of the Elasticities; Appendix Q, Method of Progressive Refinement and Narrowing of the Field of Choice. (See also W70-06853)
W70-06861

DEVELOPMENT OF THE CONCEPT OF COMPREHENSIVE WATER RESOURCES PLANNING,
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
Frederick E. McJunkin.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec. 1-3, 1965, Urbana, Illinois, 1966, p 106-119, 74 ref.

Descriptors: *Federal project policy, *Institutional constraints, History, Legislation, *Water resources development, *Multiple purpose projects, Tennessee Valley Authority Project, Project purposes.
Identifiers: *Comprehensive planning, *Gallatin Report, '308' Reports, Flood Control Acts, Inter-Agency River Basin Committee.

The development of the concept of comprehensive planning is reviewed to help the planner understand his institutional environment, especially those features which tend to restrict his activity. The concept had its genesis in 1808 in the Gallatin Report. In general, nineteenth century water resources development was largely concerned with navigation although elements of multipurpose development were forming by the end of the century. The conservation movement under Theodore Roosevelt, the '308' Reports, and the work projects, Tennessee Valley Authority Act, Flood Control Acts, and Federal Inter-Agency River Basin Committee created during the depression and war years are discussed. The decade following World War II was fraught with controversy. From 1959 to 1961, the Senate Select Committee on National Water Resources worked to create a unified policy. Recent policy developments are largely legislative acts foreshadowed by the Report of the Select Committee. Comprehensive planning as presently conceived has three dimensions: (1) physical purpose; (2) basin scale; and (3) goals. The roots of most conflicts lie in the choice of goals. The article suggests that such conflicts are inevitable, accentuated by the multiplicity of agencies and statutory authorizations involved. (Gossen-Chicago)
W70-06931

TECHNIQUES IN THE APPLICATION OF ENGINEERING ECONOMY TO WATER RESOURCES DEVELOPMENT,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
L. Douglas James.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec 1-3, 1965, Urbana, Illinois, 1966, p 120-127, 2 fig.

Descriptors: *Value engineering, *Decision making, Optimization, Competing uses, Economic feasibility, Evaluation, Investment, Costs, Benefits, *Project feasibility, *Project purposes, Intangible benefits, Intangible costs, Marginal benefits, Marginal costs.

An engineering economy procedure for investigation of the consequences of investment alternatives is described. Three questions must be answered for each alternative expenditure: (1) why do it at all; (2) why do it now; and (3) why do it this way. Answering the first two questions involves four steps: (1) define the nature and scope of the project and describe its beneficial and detrimental consequences; (2) convert consequences into commensurable units (dollar value), and tabulate consequences that cannot be assigned a monetary value; (3) use discounting to make monetary values at different times commensurable; and (4) compare the monetary values and tabulated intangibles of the various alternatives. The methods of measuring value and the kinds of research necessary to improve economic analysis vary with project purposes, seven of which are discussed: (1) flood control; (2) land drainage; (3) navigation; (4) hydroelectric power; (5) water supply; (6) recreation; and (7) water quality control. Answering the third question involves three steps: (1) select the optimum degree of service by equating marginal benefits and marginal costs; (2) select the optimum area served by separating those points with favorable benefit-cost comparisons; and (3) select the details of the optimum design to produce the desired output at the minimum cost. (Gossen-Chicago)
W70-06932

TRENDS IN PLANNING OF WATER RESOURCES PROJECTS,
Harza Engineering Co., Chicago, Ill.
V. A. Koelzer.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec 1-3, 1965, Urbana, Illinois, 1966, p 135-145, 1 fig, 1 tab, 1 ref.

Descriptors: *Project planning, *Methodology, Flexibility, Water supply, Water quality, Social change, City planning, Legislation, Water Resources Planning Act, Water Quality Act, Multiple purpose, *Project benefits, Evaluation, *Water resources development, Intangible benefits, Intangible costs.
Identifiers: *Trends, Comprehensive planning.

Current trends in planning of water resources projects are described. Three factors seem to be causing the current changes: (1) a growing recognition of potential deficiencies in water quantity and water quality; (2) a radical change from a simple to a complex society, accompanied by growing affluence; and (3) a growing recognition by lower levels of government that they must accept their share of responsibility in water resources decisions. These three changes are reflected in changes in legislation and in the procedures used to plan water resources projects. The first three sections of the paper discuss the three factors of change. The remaining two discuss legislation and planning procedures. Important examples of recent legislation include the Water Resources Planning Act of 1965 and the Water Quality Act of 1965. The advantages of creating a national resources commission are considered. Societal and legal changes have created the following requirements for water resources planning: (1) comprehensive and multipurpose planning; (2) methods to evaluate project benefits; (3) new and imaginative ways to develop and control water resources; and (4) recognition of the uncertainties that exist in water resources planning. Inherent in all of these requirements is the ability to maintain flexibility in planning. (Gossen-Chicago)
W70-06933

COMPREHENSIVE RIVER BASIN PLANNING,
James S. King.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec 1-3, 1965, Urbana, Illinois, 1966, p 128-134, 2 ref.

Descriptors: *Decision making, *Methodology, Investment, *Competing uses, Short-term planning, Long-term planning, Multiple purpose, Inter-agency cooperation, Data collections, Legislation.
Identifiers: *River basin planning, *Comprehensive planning, Multiple means, Economic distribution, Decision-making criteria, Multiple-discipline planning, Research developments.

River basin planning is seen as a technique of public investment decision making to allocate resources among competing claims. In specific plans, the goal is to provide the best use, or combination of uses, of water and related land resources to meet all foreseeable short- and long-term needs. To this end, all relevant means, singly, in combination, or in alternative combinations, reflecting different basic choice patterns, must be used. The body of the paper describes the analyses necessary to create such alternatives. Nine guideposts for decision making are discussed: (1) analyses should be accomplished within the context of total investment planning for all sectors of the economy; (2) pure economic efficiency is not necessarily the predominant criterion for determining the scope of investment; (3) all effects and all persons or groups affected must be considered; (4) planning must involve experts in several disciplines; (5) inter-agency cooperation is essential; (6) decisions must be based on adequate data; (7) engineers must strive to understand basic water laws and authorities; (8) individual projects cannot realize optimum benefits without an overall plan for the basin; and (9) analyses should reflect the advantages of the many recent developments in the planning process. (Grossen-Chicago)
W70-06934

RECREATION IN WATER RESOURCES DEVELOPMENT,
Resources for the Future, Inc., Washington, D.C.
For primary bibliographic entry see Field 06D.
W70-06936

THE EMBATTLED COLOSSUS: NEW YORK CITY WATER SUPPLY SYSTEM, ITS PAST, PRESENT, AND FUTURE,
New York City Environmental Protection Administration.
For primary bibliographic entry see Field 03D.
W70-06939

WATER FOR CITIES,
Corps of Engineers, Washington, D.C.
William F. Cassidy.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 34-41.

Descriptors: *Water supply, *Decision making, *Interstate compacts, Interstate commissions, *Planning, *Coordination, *Institutions, *Technology, Organizations, Water quality control, Waste water treatment, Storage, Inter-basin transfers, Multiple-purpose project.

Solutions to the problem of city water supplies will be found in three main areas of endeavor: Careful comprehensive planning; coordination between affected organizations and interests; and the selection or creation of institutions to carry out the work. It is suggested that the tendency to think of city and country as separate or opposed is going to be a major problem. Technological means of dealing with water supply factors-quantity, quality, time, and place--are reviewed. The use of storage facilities for time considerations, the use of large-scale interbasin transfers of water for place considerations, and means of managing waste water to increase quantity are mentioned. Technological inadequacies in improving water quality is suggested as being correctable by treatment at the source. Planning considerations are reviewed and indicate the need for providing institutions through which decision making can take place. Conflicting priorities in the allocation of limited water availability, and the need for multipurpose programs and multidisciplined approaches are pointed out. Experiences in Basins are reviewed in terms of their coordination and levels of comprehensive participation. Among several institutions thought to be effective in meeting these needs are: the interstate compact providing for the interstate commission; the federally created entity governed by a federally appointed commission, and the State Water plan involving interchanges between several intra-State river basins. (Preckwinkle-Chicago)
W70-06940

METROPOLITAN AREA WATER RESOURCE PROBLEMS,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
William Whipple, Jr.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 42-50, 9 ref.

Descriptors: *Water resources development, *Planning, *Intangible costs, *Attitudes, *Coordination, *Urbanization, *Economic efficiency, *Systems analysis, Delaware River Basin Commission, Waste identification, Standards, Waste treatment, Flood plains.
Identifiers: *Interdisciplinary planning, Ruhr agencies.

Former resource development projects by the federal government have placed the control of nature as their primary importance, but in metropolitan areas conditions are forcing a reconsideration of the traditional engineering approach. Development in flood plains becomes a more urgent problem with space as a premium; and the 'economic efficiency' approach to planning is being increasingly challenged by other objectives such as maximizing income redistribution. Systems analysis and interdisciplinary planning are important new ideas, however, there are dangers in trying to quantify intangibles or being unduly impressed with what a computer is capable of doing. Interdisciplinary planning must first set down which functions the various fields focus upon. Plans allowing for both flexibility and maintenance of standards are suggested with increasing use of advanced computational techniques, increased interagency and inter-interest coordination in preliminary and final stages of planning, greater consideration of intangibles and public attitudes, and a gradual increase in the number of social scientists involved. The existence of major unrecorded waste sources combined with the diversity of known sources add to enforcement difficulties. Federal expenditures and policies against evaluating clean water in economic terms are questioned. Similarly, problems in unifying all water resources planning and management into a single process are mentioned. The Delaware River Basin Commission and the Ruhr agencies in Germany are mentioned as meeting new organizational problems. (Preckwinkle-Chicago)
W70-06941

WATER RESOURCES PLANNING FOR MULTIPLE OBJECTIVES,
Corps of Engineers, New York. North Atlantic Div.
Harry E. Schwarz.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 183-189, 2 fig.

Descriptors: *Planning, *Watershed management, State governments.
Identifiers: *Multiple objectives, *Corps of Engineers, *Environmental quality, *Regional development, *National efficiency, *Needs, *Resources.

The needs of people must be held at the forefront of all planning processes. Experimentation by the Corps of Engineers has involved multiple-objective planning aimed at closing the 'information-gap' in basin planning, and making choices explicit. Three objectives are mentioned for the North Atlantic Region: environmental quality, regional development, and national efficiency. Explanations of each objective and reasons for selecting them are given; a schematic representation indicates how combinations of the objectives can be divised. In focusing on one objective the fulfillment of some portion of the other objectives cannot be overlooked. Careful consideration of objectives and possible technical or institutional alternatives is stressed. Plan formulation is to be carried out by a work group bringing together specialists from all states and from the Federal agencies concerned. Formulation of plans involves relating three components: needs or demands, resources, and devices. These components are defined with two groups of devices distinguished, active devices and passive devices. Active devices change or manage resources to fill demands and passive ones effect the demands so that existing resources suffice. A three-dimensional matrix can be constructed to show the interrelations of all the components; and it is suggested that there is a unique point for each combination of the three. This matrix is then related back to the multiple objectives scheme to show their workability together. (Preckwinkle-Chicago)
W70-06944

REGIONAL PLANNING AND FLOOD PLAIN MANAGEMENT,
Pennsylvania State Planning Board, Harrisburg, Pa.
For primary bibliographic entry see Field 06F.
W70-06945

COMPREHENSIVE FLOOD PLAIN MANAGEMENT REQUIRES BLENDING OF TECHNOLOGY AND SOCIAL FACTORS,
For primary bibliographic entry see Field 06F.
W70-06946

CITIZEN ACTION IN WATER,
Trinity River Authority of Texas, Arlington.
David H. Brune.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 296-303.

Descriptors: *Water resources development, *Projects, *Technical societies.
Identifiers: *Citizen action, *Information groups, *Citizen voter, National Rivers and Harbors Congress, National Reclamation Association, Sierra Club, De Witt-Gonzales River Association, San Antonio Conservation Society.

With the assumption that an active, well-informed citizenry is the key to future development of America's water resources, the author touches upon four areas in which there is or should be citizen action in water. The first of these considers the citizen as member of an organized group and here four distinct directions are perceived: groups affirmatively supporting water resources development programs, groups opposing specific projects, technical groups, and information groups. Examples are outlined for each of these with short descriptions. Extended attention is given to one of the groups opposing specific projects--the De Witt-Gonzales River Association--especially with regard to the way its appeal is presented. The San Antonio Conservation Society is viewed in contrast to be directed toward positive goals with 'reasonable considerations' in its opposition. The second area of citizen participation is as a member of a governing body of a governmental entity. No specific illustrations are given but the need to evaluate alternative solutions and make policy decisions based on a wide spectrum of factors summarized in the term 'public interest' is emphasized. The third area of participation is as a voter and four categories of elections are brought up: election of public officials, approval of water supply contracts, approval of Ad Valorem taxes, and approval of bond issues. The final area involves the citizen as the person who pays the bill, and emphasis is placed on fully informing the public. (Preckwinkle-Chicago)
W70-06949

CITIZEN ACTION IN WATER--ASSET OR LIABILITY,
Water Resources Association of the Delaware River Basin, Philadelphia, Pa.
Paul M. Felton.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 304-309.

Descriptors: *Delaware River Basin Commission, *Conservation, *Water resources development.
Identifiers: *Citizen action, *Delaware river basin, *Water Resources Association of the Delaware River Basin, Delaware Valley Conservation Association, Single-purpose associations, Multi-purpose planning, Comprehensive planning.

Citizen action in the Delaware basin is described with illustrations of 'the good and bad sides' and it is left up to reader to decide whether they are 'a net asset or liability.' Although the Delaware River Basin is one of the smallest in the country, it provides water to help serve about 30 million people. In addition, there are more citizen organizations working for water conservation in this basin than in any other in the country. The watershed movement started with the Brandywine Valley Association in the 1940's and has included 18 watershed associations covering about 12 per cent of the Delaware River Basin. Two illustrations are given of single-purpose watershed associations and a third is described as having laid the ground work for a multi-purpose comprehensive plan for county development. The Delaware River Basin Commission is described as having hired a watershed planner with the stated objective of helping to develop other grass roots, resource-oriented, citizens groups throughout the basin. However, of the 18 associations that have existed in the Basin only seven are really active. The author, executive director of the Water Resources Association of the Delaware River Basin describes his group and lists the keys necessary to maintain an effective working group--real problems, concerned citizenry, dynamic leadership, and cooperative agencies. It is urged that when citizens do not like a program they research acceptable new ones that will be better. The type of action to be discouraged is illustrated by four cases where the sole purpose was to stop water development. (Preckwinkle-Chicago)
W70-06950

ARE WE OR ARE WE NOT GOING TO CLEAN UP,
Metropolitan Sanitary District of Greater Chicago, Ill.
For primary bibliographic entry see Field 05D.
W70-06951

ENVIRONMENTAL GEOLOGY AS AN AID TO URBAN AND INDUSTRIAL GROWTH IN NORTHWEST ALABAMA,
Alabama State Geological Survey, Tuscaloosa.
Paul H. Moser.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 392-398.

Descriptors: *Urbanization, *Planning, *Engineering geology, *Hydrologic data, *Engineering structures, *Geologic mapping, Groundwater, Surface waters, Water quality.
Identifiers: *Environmental geology, *Expansion corridors, Muscle Shoals.

With population increases in this country, urban and industrial expansion is anticipated as being quite dramatic. The role of environmental geology in contributing to the necessary planning is discussed with attention directed toward expansion corridors in northwest Alabama. The results of the investigations are envisioned as furnishing planners with a comprehensive, detailed, practical study, which can be used to stimulate and then maintain an orderly urban and industrial growth. Lauderdale, Colbert, and Franklin counties were the site of the first environmental investigation, a brief outline of which is included. Information concerns hydrology, associated resources, geology and engineering geology. Quantities of potential surface and groundwater are mentioned, and discussion is given to the quality (expressed in amounts of dissolved solids). The urban nucleus, the Muscle Shoals area, is briefly described in terms of population concentration. Three roughly drawn areas are seen from a geological and physiographical viewpoint, and detailed geologic maps are indicated as being avialable and extremely valuable in planning. In the Muscle Shoals area, it is concluded, 80 per cent of the slopes are gentle enough to present no difficulities for any type of planning. Finally, the importance of engineering capacity is discussed. The bearing capacity of the soil is mentioned because it determines types and sizes of footings necessary for various kinds of construction. Mentioned also in this regard is consideration of flood plains, drainage, soil classifications, mapping of sink holes, and soil thickness. (Preckwinkle-Chicago)
W70-06952

PUBLIC INVESTMENT PLANNING IN THE UNITED STATES: ANALYSIS AND CRITIQUE,
Harvard Univ., Cambridge, Mass.
Arthur Maass.
Water Spectrum, Vol. 2, No. 1, p. 1-8, Spring, 1970. 8 p.

Descriptors: *Project planning, *Multiple-purpose projects, *Benefit-cost-analysis, Federal government.

Two important techniques, multiple-purpose planning and benefit-cost analysis, for evaluating public investments in natural resources have been used since the New Deal period. The goal of multi-objective planning has not been realized, in part because of limitations that have been imposed on the use of benefit-cost analysis. The second goal, multipurpose planning, has been overdeveloped, in part because the techniques used for this end have been used to compensate for the retarded development of benefit-cost analysis. The reasons for this uneven accomplishment are explored, both those reasons owing to the evolution of the analytical techniques themselves and those that are related to bureaucratic conduct and to executive-legislative relations. (Grossman-Rutgers)
W70-06957

CRITERIA FOR FEDERAL EVALUATION OF RESOURCE INVESTMENT,
Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
Robert J. Kalter, William B. Lord, David J. Allee, and Emery N. Castle.
August 1969. 9 p, 12 ref.

Descriptors: *Evaluation, *Economic efficiency, *Cost-benefit analysis, Federal government, Investment.
Identifiers: Flood Control Act 1936.

The Flood Control Act of 1936 has been generally interpreted to imply that economic analysis of federal water resources investment be carried out under the criterion of national economic efficiency through benefit-cost analysis methods. National efficiency analysis requires that project affects to be estimated in an effort to determine if the present value of the expected benefit stream exceeds the present value of the expected cost stream. The setting in which decision criteria are to function is examined. Then the criteria problem is discussed, with emphasis on recognizing the appropriateness economic objectives other than efficiency. Finally, further recommendations are offered which would improve the evaluation of public investments in water and related natural resources. (Grossman-Rutgers)
W70-06959

WATER RESOURCES OF IOWA.
Iowa State Geological Survey, Iowa City.

Horick, Paul J., editor. Proceedings of Symposium held at Iowa Academy of Science at the University of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, Jan 1970. 175 p.

Descriptors: *Water resources, *Iowa, Precipitation (Atmospheric), Surface waters, Groundwater, Water quality, Water utilization, Floods, Water pollution, Water law, Water management (Applied), Economics, Research and development.
Identifiers: Water resources management.

This monograph contains eleven papers that were presented at a Water Resources Symposium held at the Eighty-First session of the Iowa Academy of Science at the University of Northern Iowa on April 18, 1969. It is a summary of some of the more important segments of the water resource situation in Iowa. The topics discussed include precipitation, surface water resources, groundwater resources, water quality, water use, floods, pollution, water law, water resources management, economic considerations in water planning, and the importance of water resources research. (See also W70-06982 thru W70-06988). (Knapp-USGS)
W70-06981

MANAGEMENT OF IOWA'S WATER RESOURCES,
Office of Water Resources Research, Washington, D.C.
H. Garland Hershey.
In: Water Resources of Iowa, Symposium Proceedings, Iowa Academy of Science at Univ of Northern Iowa, Cedar Falls, April 18, 1969. Published by University Printing Service, Iowa City, p 123-140, Jan 1970. 18 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Water management (Applied), *Water law, *Water resources development, *Iowa, Legislation, Groundwater, Surface waters, Conjunctive use, Injection wells, Water rights.

Identifiers: Water resources management (Iowa).

Iowa has one of the most comprehensive mechanisms in the United States for the overall management of surface- and groundwater resources. The facilities for managing water are largely at hand through laws, policies and procedures now operable; and in Iowa, unlike most other states, they apply to both surface and groundwaters. Flood-plain zoning is permissible in Iowa and acceptance of it is growing. Disposal of wastes underground is prohibited and at present it is the policy of the state to discourage any waters to be diverted underground. Priority of use has not been set in Iowa except that private-domestic and a few other uses are not regulated. In areas where large water users concentrate in restricted areas, protected low flows are established for streams on a formula basis. There is a growing tendency to look to the principle of conjunctive use. (See also W70-06981). (Knapp-USGS)
W70-06988

THE GRAND CANYON CONTROVERSY: LESSONS FOR FEDERAL COST-BENEFIT PRACTICES,
RAND Corporation, Santa Monica, Calif.
Alan Carlin.
Land Economics, Vol 44, No 2, p 219-227, May 1968. 12 ref.

Descriptors: *Water resources development, *Cost-benefit analysis, *Project planning, *Economic justification, *Colorado River Basin, Colorado River, Cost-benefit ratio, Economics, Interest rate, Discount rate, Feasibility, Feasibility studies, Costs, Benefits, Economic feasibility, Project feasibility, Project benefits, Dams, Reservoirs, River basin development, Alternative costs, Governments, Water resources, Transmission (Electrical).
Identifiers: *Grand Canyon (Ariz), *Water resources projects, *Bureau of Reclamation, *Colorado River Basin Project, *Central Arizona Project.

The proposal to build two dams in the Grand Canyon as part of the Colorado River Basin Project precipitated a controversy between economists and conservationists on the one hand and government agencies (especially the Bureau of Reclamation) on the other. Among the questionable cost-benefit practices used by the Bureau to justify building the dams were: (1) choice of the 'most likely' alternative rather than the least cost alternative; (2) use of higher interest rates and taxes in evaluating alternatives to the projects; (3) use of unreasonable assumptions with regard to the transmission costs of alternatives; (4) use of interest rates below current costs of borrowing by the federal government when computing proposed project costs. All of these practices are at variance with accepted economic principles and raise the important question of whether federal water agencies can objectively evaluate projects they will later be asked to build. Political realities point to the mutual interests of members of Congress anxious to obtain federal projects for their areas and federal water agencies looking for business. Although a new set of economic guidelines is necessary, so is an impartial group to apply them to proposed water projects. (Carr-Arizona)
W70-07054

INSTITUTIONAL CONSTRAINTS AND ECONOMIC OPTIMA - A BASIS FOR MANAGEMENT DECISIONS IN INTRAREGIONAL WATER TRANSFER,
California Univ., Berkeley.
C. Dirck Ditwiler.
Land Economics, Vol 44, No 2, p 173-184, May 1968. 16 ref.

Descriptors: *Water transfer, *Decision making, *Economics, *Institutional constraints, *Political constraints, California, Water resources, Water policy, Administration, Water allocation (Policy), Governments, Institutions, Groundwater, Overdraft, Water supply, Economic efficiency, Welfare economics, Legal aspects, Analysis, Model studies, Salinity, Semiarid climates, Optimum development plans.
Identifiers: *Economic optimum, Salinas Valley (Calif), Water economy.

The groundwater overdraft problems of the Salinas Valley of California are used as the focal point of an analysis of optimal water management rationale for intraregional water transfer. Traditional economic solutions and their modern counterparts are considered. The analysis suggests that, in contrast to what would be possible in an unconstrained context of economic optimality, the political-institutional-economic structure of the local water economy has prevented almost all movement toward an economic efficiency solution. Changes in institutional structures and forces are likely to be very slow. Therefore, an attempt is being made to create a quantitative model which would recognize these variables and constraints in developing specific operating rules for water management in the valley. (Carr-Arizona)
W70-07055

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOLUME II, APPENDIX.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-06839

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOLUME III, (SEWERAGE CHARGES).
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-06840

THE COST OF CLEAN WATER AND ITS ECONOMIC IMPACT, VOL. IV. PROJECTED WASTE WATER TREATMENT COSTS IN THE ORGANIC CHEMICALS INDUSTRY.
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 06B.
W70-06841

ESTIMATING CONSTRUCTION COSTS OF WASTE WATER TREATMENT SYSTEMS,
Auburn Univ., Ala. School of Engineering.
For primary bibliographic entry see Field 05D.
W70-06842

CHAPTER 10: SOME ISSUES IN PRESENT PRACTICES OF PROJECT EVALUATION.
Washington Univ., St. Louis, Mo.
For primary bibliographic entry see Field 06B.
W70-06860

COST OF CONVENTIONAL AND ADVANCED TREATMENT OF WASTE WATER,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
For primary bibliographic entry see Field 05D.
W70-06869

THE ECONOMICS OF WATER QUALITY,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
For primary bibliographic entry see Field 05G.
W70-06937

ECONOMICS OF IRRIGATION SYSTEM CONSOLIDATION,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 03F.
W70-06956

6D. Water Demand

WATER USE IN TENNESSEE: PART C - MUNICIPAL WATER USE,
Geological Survey, Nashville, Tenn.; and Tennessee Dept. of Conservation, Nashville. Div. of Water Resources.
Alfred M. F. Johnson, and John M. Wilson.
Tennessee Department of Conservation, Division of Water Resources Report, 1970. 22 p, 1 fig, 11 tab, 9 ref.

Descriptors: *Water utilization, *Municipal water, *Tennessee, Water users, Water demand, Data collections, Surveys, Water management (Applied), Water requirements.
Identifiers: Municipal water use (Tenn).

To implement the water-use registration law, which was passed by the 1963 Tennessee General Assembly, the State Division of Water Resources undertook a water-use survey in 1964. A questionnaire was distributed to all known municipalities with community-wide distribution systems. Three-fourths of the population of the State are furnished water by a municipal or community-wide distribution system. In 1964 over 400 systems provided 2,750,000 people with a daily supply of 105 gallons of water per person. Average daily water-use ranged from about 75 gallons per person for small communities, to almost 115 gallons per person in the metropolitan areas. During the 4-year period, 1961-64, there was a net increase of about 10% in the number of water distribution systems. The rate of increase will depend on the availability of an adequate supply of potable water, economics, and the urbanization pattern. (Knapp-USGS)
W70-06735

URBAN AND INDUSTRIAL WATER SUPPLY: PROSPECTS AND POSSIBILITIES,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
Jabbar K. Sherwani.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec 1-3, 1965, Urbana, Illinois, 1966, p 189-207, 17 ref.

Descriptors: *Water supply, *Water demand, *Future planning (Projected), Water utilization, Water users, Urbanization, Economic life, Public health, Human population, Technology, Methodology, Standards, Regulation, Legal aspects, Groundwater, Surface waters, Water reuse, Waste water treatment, Demineralization.
Identifiers: *Institutional changes, Agricultural demand, Industrial demand, Municipal demand, Regional governments.

The article is divided into three sections: (1) water demand; (2) water supply; and (3) institutional considerations. Section 1 discusses the present level and composition of water use; the future direction of water supply development, as determined by social and cultural changes, stimulation of economic growth and healthfulness of environment; the consequences of urban expansion, which signify that water supply and waste disposal should determine, rather than follow, urban physical forms; economic growth; health aspects; probable changes in water use patterns, based on population growth, economic activity and technological change; agricultural, municipal and industrial demands; future changes in regulations and standards; and the research necessary to predict future water demand. Section 2 discusses possible sources of supply. Most water will come from conventional sources: surface and ground. Major developments will be: shifts from existing uses, mostly agricultural; reuse of waste waters; technological advances in water and waste treatment; demneralization; and adjustment of water quality to use. Section 3 predicts a complete regionalization of water

supply systems, with corresponding governmental, legal and policy changes. The interrelationship between water supply and other planning activities is discussed. (Gossen-Chicago)
W70-06935

RECREATION IN WATER RESOURCES DEVELOPMENT,
Resources for the Future, Inc., Washington, D.C.
Jack L. Knetsch.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec 1-3, 1965, Urbana, Illinois, 1966, p 182-188, 9 ref.

Descriptors: *Recreation demand, *Decision making, Methodology, Evaluation, *Recreation facilities, *Project planning, Forecasting, Economics, Demand, Supply.
Identifiers: *John Kerr project.

Current interest in recreation is a demand but not a need. It focuses on two issues relating to the use of water resources for recreation: (1) economic evaluation of recreation services produced by water projects and the implications for project planning; and (2) projection of demand and use of outdoor recreation facilities. The recommended method for calculating recreation benefits is based on an imputed demand curve for recreation facilities, using travel cost data as a proxy for price. The method is illustrated with the case of an existing reservoir--the John Kerr project of the Corps of Engineers located in Virginia-North Carolina. The dangers are discussed of putting recreation on an equal selection basis with traditional alternatives. Past statements of demand have not been true projections of demand, but projections of consumption. The data they have been based on are attendance figures. The figures in themselves do not separate demand and supply and therefore have limits to their conceptual or statistical value. Another important and under-considered factor is the possibility of substitution between different kinds of activities or facilities to meet recreation demand. (Gossen-Chicago)
W70-06936

WATER REQUIREMENTS OF WATER-FOWL MARSHLANDS IN NORTHERN UTAH,
Utah Water Research Lab., Logan; and Utah State Univ., ogan. Cooperative Wildlife Research Unit.
J. E. Christiansen, and J. B. Low.
Utah Division of Fish and Game Publication No 69-12, 1970. 108 p, 24 fig, 31 tab, 52 ref.

Descriptors: *Consumptive use, *Wetlands, *Water quality, *Water requirements, *Utah, Aquatic habitats, Fish, Aquatic life, Waterfowl, Aquatic plants, Evapotranspiration, Evaporation, Transpiration, Data collections, Hydrologic data, Water management (Applied), Water conservation.
Identifiers: Waterfowl marshes.

The use of water by the marshlands of northern Utah, as indicated by calculation of evapotranspiration from inflow-outflow data, varies from about 4 in. in April to 9 in. in June, decreasing to 3 in. in October for a 7-month total of about 41 in. These determinations were correlated with climatic data to determine the monthly coefficient K according to the Blaney-Criddle formula, which was used to estimate consumptive use. Values of K for the Blaney-Criddle formula varied from 0.90 for April to 1.20 for June, decreasing to 0.60 for October. Water varied in quality from excellent to poor. Relationships were developed for estimating monthly water requirements based on considerations of evapotranspiration, quality of water, and precipitation. Recommendations are made on quality and quantity of water, drainage, desirable water levels, and desirable plants for efficient marshland operation. (Knapp-USGS)
W70-06995

HIGHEST AND BEST USE: AN ECONOMIC GOAL FOR WATER LAW,
For primary bibliographic entry see Field 06E.
W70-07067

HIGHEST AND BEST USE: AN ECONOMIC GOAL FOR WATER LAW (REASONABLE USE VERSUS BENEFICIAL USE AND THE CONCEPT OF 'HIGHEST AND BEST USE'),
For primary bibliographic entry see Field 06E.
W70-07069

6E. Water Law and Institutions

ZIMMERMAN V UNION PAVING CO. (ACTION TO RETAIN WATER RIGHTS).

134 Pa Super 372, 4 A 2d 319-324 (1939).

Descriptors: *Pennsylvania, *Easements, *Excavation, *Water rights, Right-of-way, Springs, Judicial decisions, Legal aspects, Spring waters, Seepage, Prescriptive rights, Damages, Relative rights, Competing uses, Gravitational water, Obstruction to flow, Alteration of flow.

In his deed plaintiff was granted a right to conduct water from a designated spring on grantor's land through a pipe to plaintiff's premises and a right to obtain his water from another unnamed spring. Plaintiff laid pipe from both springs and conveyed water to his premises for over 8 years. Defendant, a road paving company, acquired from plantiff's grantor the right to excavate soil from the grantor's land. The excavation site was at the base of a hill on which the unnamed spring was located. Defendant's superintendent was notified of the seepage of water from and the possible damage to the unnamed spring from excavation. As a result of the continued excavation, the water flow through plantiff's pipe was halted, and plaintiff had to transport the water from the unnamed spring by hand. Plaintiff's action for trespass to recover for the interference with and destruction of his property right in the unnamed spring resulted in a favorable judgment at the trial court. The Pennsylvania Superior Court, in affirming, held that where the deed giving plaintiff the right to water from the spring on grantor's remaining land was uncertain as to the identity of the spring and the manner of use, but water was piped by the plaintiff for over eight years without objection, defendant could not claim that the piping of water was unauthorized. (Powell-Florida)
W70-06759

STATE EX REL STATE HIGHWAY COMM'N V ESSELMAN (CONDEMNATION OF PROPERTY FORMED BY ACCRETION).
179 SW2d 749-752 (Mo Ct App 1944).

Descriptors: *Missouri, *Condemnation, *Boundaries (Property), *Accretion (Legal aspects), Land tenure, Eminent domain, Legal aspects, Levees, Farms, Land use, Drainage, Culverts, Ditches, Boundary disputes, Damages, Judicial decisions, Riparian land, Right-of-way, Condemnation value, Road construction, Rivers, Highways.

During proceedings to condemn land for road construction, the defendant condemnees claimed damage to land formed by accretion. The plaintiff condemnor argued that defendants did not own the property. In order for the owner of a tract of land to have the right to land formed by accretion, argued the plaintiff, the river itself, not metes and bounds or other descriptions, must be made the boundary. The plaintiff claimed that as no evidence had been adduced to show that the river was the boundary of the defendants' property, the defendants could neither show ownership of the accreted land nor claim damages for it. The court conceded the correctness of the argument as to the necessity for the river boundary, but pointed out that no question had been raised at trial as to ownership of the property in question. Further, defendants cultivated the tract as part of their farm and all parties had considered it as part of defendants' farm. Under these facts, defendants were declared to be the owners of the land, formed by the accretion. (Caldwell-Florida)
W70-06822

KENTUCKY RIVER COAL CORP V MAYNARD (BOUNDARY DISPUTE: AVULSION OR ACCRETION).
120 SW2d 401-404 (Ky 1938).

Descriptors: *Kentucky, *Boundary disputes, *Avulsion, *Accretion (Legal aspects), Alteration of flow, Streams, Boundaries (Property), Bank erosion, Land tenure, Surveys, Meanders, Ditches, Dams, Obstruction to flow, Railroads, Legal aspects, Judicial decisions, Roadbanks, Riparian rights, Streamflow, Channels.

Defendant claimed ownership of a small tract of land lying on plaintiff's side of a stream which was the common boundary for some distance between plaintiff's and defendant's property. Defendant's contention was that the construction of a railroad some years before, running parallel with the creek, had changed the course of the stream by avulsion. Plaintiff sought to enjoin the defendant from digging a ditch along the old channel and constructing a dam in order to reroute the creek along the ditch. The court held that the defendant had the burden of proving that the creek had changed course by avulsion and that as he had failed to sustain this burden, a change by accretion would be presumed. The plaintiff was held to have title to the land formed by accretion. Defendant sought to establish that his deed laid out the boundary by courses and distances and included the disputed tract. Other language in the deed, however, called for the boundary to run with the meanderings of the stream, and the court held that in case of such a conflict, the meanders of the stream prevailed. Plaintiff was thus held entitled to an injunction. (Caldwell-Florida)
W70-06836

CONNECTICUT'S ADMINISTRATIVE CONTROL OF WATER POLLUTION -- THE FLUID ADMINISTRATIVE PROCESS,
Connecticut Univ., Inst. of Water Resources.
For primary bibliographic entry see Field 05G.
W70-06844

WATER LAW IN THE UNITED STATES,
Wyoming Univ., Laramie. Coll. of Law.
Frank J. Trelease.
Proceedings of the First Annual Meeting of the American Water Resources Association at the University of Chicago, Dec 1-3, 1965, Urbana, Illinois, 1966, p 47-54.

Descriptors: *Water law, *History, Water resources development, *Prior appropriation, *Riparian rights, Water permits, Federal jurisdiction, State jurisdiction, Recreation, Planning, Water supply.
Identifiers: Groundwater law, Institutional law, Water quality laws, Federal Water Pollution Control Act, Inflexible laws.

An overview is provided of present water laws and compares them with those of the past, emphasizing that the law is beneficial rather than restrive and that it can be changed as the will of the majority changes. Section I shows how the law encourages development. The law of prior appropriation spurred water resources development in a pioneer economy. Present appropriation laws require the granting of a permit to appropriate water. Using this power, western water officials have chosen from competing projects the ones which promised the greatest benefits. Evolvement of the riparian rights laws, groundwater law, institutional law, and federal development has followed the same pattern of advancing the good of the people. Section II con-

siders water quality laws at the state and federal levels. It traces the development of legal control from the days of private suits for private nuisances to the passage of the Federal Water Pollution Control Act. Section III marks trends concerning recreation use, water supply planning, and inflexible laws and plans. It is predicted that water law in the future will continue to undergo revision according to the will of the majority. (Gossen-Chicago)
W70-06930

CRITERIA FOR FEDERAL EVALUATION OF RESOURCE INVESTMENT,
Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
For primary bibliographic entry see Field 06B.
W70-06959

AGRICULTURAL DEVELOPMENT IN NORTHERN MEXICO, 1940-1960,
Stanford Univ., Calif.
For primary bibliographic entry see Field 03F.
W70-07052

INSTITUTIONAL CONSTRAINTS AND ECONOMIC OPTIMA - A BASIS FOR MANAGEMENT DECISIONS IN INTRAREGIONAL WATER TRANSFER,
California Univ., Berkeley.
For primary bibliographic entry see Field 06B.
W70-07055

COLD FACTS ON HOT WATER: LEGAL ASPECTS OF THEMAL POLLUTION,
For primary bibliographic entry see Field 05G.
W70-07059

TECHNOLOGY, OCEAN MANAGEMENT, AND THE LAW OF THE SEA: SOME CURRENT HISTORY,
Edward Miles.
Denver Law Journal, Vol 46, No 2, p 240-260, Spring 1969. 21 p, 74 ref.

Descriptors: *Oceans, *International waters, *Jurisdiction, *Resource development, Technology, Legal aspects, International law, International commissions, United Nations, Mineralogy, Mining, Oil, Drilling, Fishing, Fisheries, Weather, Climates, Economics, Political aspects, Continental shelf, Navigation, Treaties, Oceanography, Exploration, Exploitation, Military aspects, Management, Ownership of beds, Beds under water.
Identifiers: *Ocean floor, *Territorial sea.

The law of the sea is beset with many problems regarding claims of national jurisdiction over the ocean floor contigious to nation-states. The two areas of controversy are conflicting claims of territorial sea and the extent of jurisdiction over the ocean floor for exploration and exploitation of resources. Advancing marine technology has made the second area more important because of its impact both on economics and national security. Since 1930 there have been several international conferences dealing with the extent of the territorial sea. Unanimity of policy has never been achieved but there has been a trend towards more nations claiming limits greater than the traditional three mile limit. The problem over jurisdiction of the continental shelf derives from the ambiguous wording of the 1958 Geneva Convention on the Continental Shelf. A nation can claim jurisdiction over the ocean floor beyond water depths of 200 meters if it is able to exploit the resources of these areas. With recent technological innovations in drilling, mining, fishing, and weather prediction such exploitation is now possible. The effect of these innovations has been to extend coastal states' jurisdiction beyond the traditional limits. The need for some sort of definitive agreement among nations is evident. A workable international system should be established which would insure the national security of participating nations. (Duss-Florida)
W70-07060

THE OUTER LIMIT OF THE CONTINENTAL SHELF,
Luke W. Finlay.
American Journal of International Law, Vol 64, No 1, p 42-61, Jan 1970. 20 p, 69 ref.

Descriptors: *Continental shelf, *International commissions, *International law, *Continental slope, Standards, Continental margin, Oceans, International waters, Law of the sea, Federal government, Legal aspects, Exploration, Exploitation, Oil industry, Political constraints, Political aspects, Judicial decisions, Beds under water, Ownership of beds, Institutional constraints, Governments, United Nations, Foreign countries, Conferences.

The Geneva Convention on the Continental Shelf of 1958 laid down the standard that coastal nations have sovereign rights over continental shelves to a depth of 200 meters, the approximate limit of most continental shelves, or to such depth beyond 200 meters as is reasonably exploitable. A split of authority has arisen over whether this standard should be interpreted to include all the geographical continental shelf, even beyond the 100 meter standard. The author supports the interpretation that all the shelf should be exploitable, opposing the view that an arbitrary standard of a given number of miles from shore should prevail. The author argues that both the shelf and the continental slope were intended to be controlled by the coastal nation. An earlier inter-American conference adopted provisions supporting this thesis. Such provisions were approved and implicitly adopted by the Geneva Conference. The author contends that a limit in terms of miles from shore would be arbitrary and that extending the limit to a greater depth would result in excessive amounts of ocean beds being claimed by coastal nations. Defining the limits of the continental shelf as its geographical area, including the continental slope, is reasonable and more susceptible of international agreement and support. (Caldwell-Florida)
W70-07061

JURISDICTION OF THE FEDERAL POWER COMMISSION OVER NON-POWER WATER USES,
William R. Walker, and William E. Cox.
Land and Water Law Review, Vol 5, No 1, p 65-75, 1970. 11 p, 29 ref.

Descriptors: *Federal Power Act, *Hydroelectric project licensing, *Federal project policy, *Multiple-purpose projects, Federal government, Legislation, Hydroelectric plants, Water resources development, Project purposes, Powerplants, Structures, Flood control, Water utilization, Dams, Reservoirs, Reservoir management, Non-consumptive use, Recreation, Water allocation (Policy), Multiple-purpose reservoirs, Usable storage, Permits, Beneficial use, Navigable waters.

New legislation and the Federal Water Power Act (FWPA) seem to provide the authority for the Federal Power Commission to play a larger role in the storage of water for non-power used in the future. The FWPA shifted the responsibility for licensing non-federal water resource projects from Congress to the Federal Power Commission. The FPC was directed to think in terms of comprehensive development plans. It was also authorized to act, after a license is issued, to alter and impose additional requirements on the licensee. It cannot act unilaterally, but it can impose open-end conditions at the time of issuance. In 1968 the FWPA was amended to allow non-power uses to be incorporated into new licensing agreements. In addition to issuing licenses for power projects in navigable waters or on public lands, the FPC may issue licenses for utilizing surplus water from any government dam for any beneficial public use, including non-power purposes. The legislative history of the Act indicates that the drafters contemplated this authority. Also, a prior act that dealt with non-power projects was repealed, and its provisions were integrated into the FWPA. (Douberley-Florida)
W70-07062

OHIO SURFACE WATER RIGHTS,
S. M. Nechemias.
University of Cincinnati Law Review, Vol 38, No 3, p 525-538, Summer 1969. 14 p, 82 ref.

Descriptors: *Ohio, *Reasonable use, *Surface water, *Contours, Repulsion (Legal aspects), Riddance (Legal aspects), Legal aspects, Banks, Watercourses (Legal), Land use, Flow, Channels, Drainage systems, Canals, Ditches, Surface drainage, Civil law, Easements, Streams, Ponds, Relative rights.
Identifiers: *Servitudes.

The purpose of this note is to indicate how Ohio landowners can legally use their land with respect to countour changes altering the flow of surface water. The note emphasizes the various rules pertaining to water rights of upper and lower landowners. American jurisdictions have tended to adopt either the common enemy rule, the civil law rule, or the reasonable use rule. Ohio surface water law began with the adoption of the Civil Law Rule. The capacity-of-the stream rule and the urban rule have also been significant in the history of Ohio surface water law. The author advocates the adoption of the reasonable use rule to allow for the fairest results with the greatest flexibility. Numerous judicial decisions are discussed. 'Surface water' and 'watercourse' are defined. (See also W70-07064 thru W70-07066) (Leesfield-Florida)
W70-07063

OHIO SURFACE WATER RIGHT (COMMON ENEMY, CIVIL LAW, AND REASONABLE USE RULES),
S. M. Nechemias.
University of Cincinnati Law Review, Vol 38, No 3, p 525-528, Summer 1969. 4 p, 21 ref.

Descriptors: *Repulsion (Legal aspects), *Reasonable use, *Civil law, *Surface runoff, Surface waters, Land tenure, Drainage water, Jurisdiction, Easements, Riddance (Legal aspects), Land use, Natural flow, Legal aspects, Drainage systems, Relative rights, Contours, Judicial decisions.
Identifiers: *Servitudes.

Surface water rights in the United States have been determined by one of three rules. The common enemy rule allows the possessor of land an unlimited right of use in such land regardless of harm which he may cause to others due to a change in surface water flow. However, most courts do not allow the land possessor an unlimited privilege to rid his land of surface water. The civil law rule states that a person who interferes with the natural flow of surface water, thereby disturbing another's enjoyment of his land, is liable for damages. Thus, the upper owner's land is said to enjoy an easement for the natural flow of water over the lower owner's land. This rule permits no interference with the natural flow. When strictly applied, this rule greatly restricts the improvement of urban land. The reasonable use rule establishes no specific rights or privileges. It provides that each possessor may make reasonable use of his land, and allows for the alteration of the surface water flow. Reasonableness is a question of fact in each case. (See also W70-07063) (Leesfield-Florida)
W70-07064

OHIO SURFACE WATER RIGHTS (CIVIL LAW RULE, CAPACITY OF STREAM RULE, URBAN RULE),
S. M. Nechemias.
University of Cincinnati Law Review, Vol 38, No 3, p 528-536, Summer 1969. 8 p, 51 ref.

Descriptors: *Ohio, *Civil law, *Surface runoff, *Riddance (Legal aspects), Surface waters, Land tenure, Legal aspects, Ditches, Ponds, Overflow,

Natural flow, Streams, Watercourses (Legal), Drainage systems, Farm management, Airports, Flooding, Banks, Land development, Repulsion (Legal aspects), Urbanization, Judicial decisions, Relative rights, Easements, Land use.
Identifiers: *Servitudes, Urban rule.

Ohio surface water law began with the adoption of the civil law rule. A series of cases established a trend toward the view that the lower land is subject to a servitude in favor of the upper land and must receive water which naturally flows onto the lower land. Exceptions to this rule allowed an increase in the flow of water in natural drainways and watercourses. The capacity of the stream rule is also applied by Ohio courts. The rule provides that an upper riparian owner can increase and accelerate the stream flow only to the extent its natural banks can carry it. Ohio's urban rule is in effect a modified common enemy rule. This rule was necessitated by the fact that Ohio courts do not consistently apply the civil law rule to urban land. Determining whether land is urban or rural in Ohio is a mechanical process. Land within the corporate limits of a municipality is urban; otherwise it is rural. The reason for this rule is to encourage land improvement without the necessity of using natural water drainage. Ohio's urban rule has been limited by case law. It never applies to upper owners and only occasionally to lower owners. (See also W70-07063) (Leesfield-Florida)
W70-07065

OHIO SURFACE WATER RIGHTS (ADOPTION OF REASONABLE USE RULE),
S. M. Nechemias.
University of Cincinnati Law Review, Vol 38, No 3, p 536-538, Summer 1969. 3 p, 30 ref.

Descriptors: *Ohio, *Reasonable use, *Civil law, *Repulsion (Legal aspects), Land use, Streams, Surface waters, Ditches, Natural flow, Drains, Legal aspects, Riddance (Legal aspects), Diversion, Drainage systems, Surface runoff, Land tenure, Urbanization, Contours, Judicial decisions, Relative rights, Land development, Watercourxes (Legal).

Ohio is now forced to apply two sets of rules. When dealing with rural lands the civil law rule is justificable. However, the common enemy rule is appropriate as a general principle of urban law because city land requires severe alterations to the surface. The existence of separate rules leads to confusion. The problems of Ohio surface water law can best be solved by the adoption of the reasonable use rule. The philosophy supporting this rule simply states it is incumbent on every person to take reasonable care, in using his property, to avoid injury to others. However, a person threatened with injury must also take reasonable precautions to avoid or reduce potential injury. This rule gives maximum flexibility without resort to artificial exceptions. The rule is explicit enough to avoid confusion. Reasonableness should be based on the amount of harm caused, forseeability of harm, and all other relevant facts. The court should also consider the ability of the injured party to mitigate damages. (See also W70-07063) (Leesfield-Florida)
W70-07066

HIGHEST AND BEST USE: AN ECONOMIC GOAL FOR WATER LAW,
Donald R. Levi.
Missouri Law Review, Vol 34, No 2, p 165-177, Spring 1969. 13 p, 33 ref.

Descriptors: *Missouri, *Prior appropriation, *Reasonable use, *Water conservation, Conservation, Legal aspects, Judicial decisions, Competing uses, Riparian rights, Water allocation (Policy), Water policy, Water rights, Preferences (Water rights), Equitable apportionment, Regulation, Relative rights, Beneficial use, Economics, Marinal costs, Real costs, Cost-benefit analysis, Economic justification, Water demand, Social aspects, Legislation.

The concept of highest and best use is explored as a basis for the allocation of the increasingly scarce water supplies. The concept of highest and best use calls for the use which will yield the greatest positive net profit. This is analogous to the most beneficial use concept in economic theory in that it envisions a marginal allocation among users. Rather than viewing one use as being categorically higher valued than another, the best use concept requires that each unit of water be allocated to the use wherein the incremental value of the product produced is a maximum. The reasons for the lack of maximal use of water are examined. Legislative mechanisms are suggested to achieve the highest and best use of currently existing water supplies. Suggestions for an economically sound system of water rights are presented as a step toward bringing the highest and best use of water into reality. (See also W70-07068 thru W70-07070) (Barnett-Florida)
W70-07067

HIGHEST AND BEST USE: AN ECONOMIC GOAL FOR WATER LAW (INTRODUCTION),
Donald R. Levi.
Missouri Law Review, Vol 34, No 2, p 165-168, Spring 1969. 4 p, 14 ref.

Descriptors: *Missouri, *Reasonable use, *Beneficial use, *Conservation, Prior appropriation, Legal aspects, Judicial decisions, Competing uses, Riparian rights, Water allocation (Policy), Water policy, Water rights, Preferences (Water rights), Equitable apportionment, Regulation, Relative rights, Economics, Governments, Cost-benefit ratio, Cost-benefit analysis.

Regulating the right to use water is an economic problem when there is a water scarcity. Pollution and population increases affect the scarcity of usable supplies. Consequently, some form of governmental regulation is required. A system is needed which will optimally allocate water among competing users. Many social scientists believe the economic principle of highest and best use is the pivotal doctrine around which a system of water law ideally should be built. The theory is that society should receive the greatest possible benefit from the existing water supply. Legal scholars talk in terms of reasonable use and beneficial use. An economist defines beneficial use as one in which the value of the benefits received from usage is greater than the cost of utilization. The legal definition of beneficial use varies with cases and statutes. For example, in New Mexico beneficial use has been defined as the use of such water as may be necessary for some useful and beneficial purpose in connection with the land from which it is taken. This definition is not functional. The exact determination of beneficial use is a fact question in each case. (See also W70-07067) (Barnett-Florida)
W70-07068

HIGHEST AND BEST USE: AN ECONOMIC GOAL FOR WATER LAW (REASONABLE USE VERSUS BENEFICIAL USE AND THE CONCEPT OF 'HIGHEST AND BEST USE'),
Donald R. Levi.
Missouri Law Review, Vol 34, No 2, p 168-172, Spring 1969. 5 p, 18 ref.

Descriptors: *Conservation, *Missouri, *Reasonable use, *Beneficial use, Prior appropriation, Preferences (Water rights), Illinois, Louisana, Legal aspects, Judicial decisions, Competing uses, Riparian rights, Water allocation (Policy), Water policy, Water rights, Equitable apportionment, Regulation, Relative rights, Economics, Cost-benefit ratio, Costs, Mathematical studies, Project planning, Marginal costs, Real costs, Cost-benefit analysis, Economic justification, Natural resources, Resource allocation, Water demand.

Reasonable use and beneficial use are synonymous, but each is usually associated with a different system of water law. The question of reasonableness does not arise until there are competing users of a given source. Comparing the reasonableness of two competing uses necessitates a determination of the use with the higher value. Economists use the term highest and best use as a synonym for most beneficial use, i.e., the use giving the greater positive addition to social product, while yielding the maximum social benefit. Courts have seldom given the term highest and best use any meaning. Courts in both Illinois and Louisiana have construed the term and implicitly recognized that maximizing the extent by which marginal value product exceeds marginal factor costs is the appropriate goal and that total costs and gross returns are not the relevant criteria for water-use management decisions. The definition of most beneficial use that is acceptable to both economists and legal technicians is a combination of the legal construction of most as in the highest degree plus the economist's definition of beneficial use, which is when marginal value product exceeds marginal factor cost. (See also W70-07067) (Barnett-Florida)
W70-07069

HIGHEST AND BEST USE: AN ECONOMIC GOAL FOR WATER LAW (LEGISLATIVE MECHANISMS FOR ACHIEVING HIGHEST AND BEST USE),
Donald R. Levi.
Missouri Law Review, Vol 34, No 2, p 173-177, Spring 1969. 5 p.

Descriptors: *Missouri, *Legislation, *Economics, *Reasonable use, Prior appropriation, Conservation, Beneficial use, Permits, Preferences (Water rights), Legal aspects, Competing uses, Riparian rights, Water allocation (Policy), Water policy, Water rights, Equitable apportionment, Regulation, Relative rights, Project planning, Public health, Natural resources, Resource allocation, Water demand, Social aspects.

Statutory schemes can be employed to achieve or approximate the highest and best use concept of water allocation. The reasonable use doctrine lacks certainty in that it requires litigation to determine whether the riparian owner has in fact made a reasonable use. It does not provide the certainty of rights that will precipitate cash outlays to install diversion facilities for water use, which would minimize the potential use of water. Certainly could be added in three ways: (1) giving landowners the right to use a definitive quantity of water; (2) making a division by percentages among those presently holding usage rights in a given source, and (3) adopting a prior appropriation doctrine, with the order of diversion establishing the order of rights to water use. It is submitted that making a water right freely transferable separate from the land is important to encourage beneficial water utilization. Permit systems are also suggested, as well as an administratively enforced transfer system. Another suggestion, termed the legislative determination of highest and best use, is an ordered list of preferences among general usage classifications. Other legal mechanisms are also suggested. (See also W70-07067) (Barnett-Florida)
W70-07070

CONTEMPORARY DEVELOPMENTS IN WATER LAW.
Contemporary Developments in Water Law, Water Resources Symposium, C. W. Johnson and S. H. Lewis (editors), Vol 4, p 1-172, 1970. 172 p.

Descriptors: *Water conservation, *Water resources development, *Water law, *Water management (Applied), Water quality, Water rights, Water quality control, Water utilization, Regulation, Non-structural alternatives, Riparian rights, Administrative agencies, Federal government, Legal aspects, Legislation, Natural resources, Water allocation (Policy), Water supply, Environment engineering, Federal project policy, Multiple-purpose projects, Flood control, Competing uses, Water distribution (Applied).

Adaptation of the law of water rights to changing social conditions is discussed with both a narrow and a broad focus. Legal assurances of water quality, the relationships between water quality and water rights, and governmental efforts to achieve regional water quality management and control are examined. A model water use act for a riparian state, Florida, is reviewed. Municipal preference statutes, particularly the Texas Wagstaff Act, are analyzed. The regulation of groundwater in humid zones is discussed. Governmental flood control measures, the encroachment of land uses such as filling and building upon scenic and recreational waterways, and the crucial role of law in the planning of water resources development, including the extent to which the private citizen and the courts should have a voice in the planning process are other subjects dealt with. (See also W70-07096 thru W70-07105). (Powell-Florida)
W70-07095

A MODEL WATER USE ACT FOR A RIPARIAN STATE--THE FLORIDA EXPERIENCE,
F. E. Maloney.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 1-26, 1970. 26 p, 118 ref.

Descriptors: *Florida, *Administration, *Legislation, *Water law, Legal aspects, Interstate compacts, Prior appropriation, Riparian rights, Water permits, Water rights, Adjudication procedure, Administrative agencies, Competing uses, Regulation, Water allocation (Policy), Watershed management, Water management (Applied), Water supply, Water works, Aquifers, Dams, Water pollution, Beneficial use, Priorities, Reasonable use, Surplus water, Saline water intrusion, Hydrologic cycle, Surface groundwater relationships, Impoundments, State governments.

The need for legislation to regulate emerging water resource problem is imperative for our society today. In 1957, Florida enacted the Water Resources Law. The Law was drafted mainly with concern for the two major consumptive use problems in Florida: waste and unreasonable use. Because of weaknesses in the act regarding permit regulation of the use of excess water beyond riparian land, the Florida Model Water Use Act has been proposed. The constitutional problems of regulation of property for the general welfare are examined. Having explained the proposed Model Act's general approach and administrative structure, the provisions for water management districts, consumptive use permits, surface water works and pollution prevention controls are outlined in depth. It is concluded that the necessity of this regulation is to maximize the bneficial use of Florida's water resources in the best interests of all its citizens. (See also W70-07095). (Barnett-Florida)
W70-07096

MUNICIPAL WATER PREFERENCE STATUTES: THE TEXAS WAGSTAFF ACT,
R. W. Swenson.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 27-39, 1970. 13 p, 51 ref.

Descriptors: *Texas, *Appropriation, *Water allocation (Policy), *Preferences (Water rights), Legislation, Legal aspects, Competing uses, Beneficial use, Priorities, Water rights, Prior appropriation, Distribution, Domestic water, Equitable apportionment, Industrial water, Recreation, Water control, Water policy, Water resources development, Water utilization, Water conservation, Water demand, Water law, Water distribution (Applied), Water management (Applied).

Municipal water preference statutes give the muncipality a right to appropriate water that the city finds reasonably necessary, irrespective of the claims of water users who are prior in time, without paying compensation to them for the loss of their rights in the water. The Texas statute recites that preference and priority be given, in this order, to the following uses: (1) domestic and municipal; (2) manufacturing; (3) irrigation; (4) mining; (5) hydroelectric power; (6) navigation; and (7) recreation and pleasure. Observations in regards to the recapture powers of municipalities under the Texas statute are presented. For example, cities, in recapturing water, are probably limited to those uses which were recognized in 1931 as proper domestic or municipal uses. The legislative wisdom of the statute is explored. The statute differs from other such statutes by requiring no affirmative act on the part of the city with respect to its claims for future water. Another troublesome provision of the Texas statute is the 1931 cut-off date for the protection of vested appropriation rights. A third problem arises concerning the construction of the municipal preference statute in relation to an act governing interbasis transfers in Texas. The constitutionality of the statute, particularly the recapture provision, is discussed. The Wagstaff Act represents an extreme policy of resource allocation that appears inconsistent with state policy in other areas. (See also W70-07095). (Powell-Florida)
W70-07097

NEW WATER LAWS FOR OLD AND NEW COUNTRIES,
F. J. Trelease.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 40-54, 1970. 15 p, 72 ref.

Descriptors: *Foreign countries, *Prior appropriation, *Appropriation, *Water law, Water rights, Recreation, Natural resources, Legislation, Legal aspects, Geographical regions, Regions, Governments, Foreign waters, Research and development, Long-term planning.
Identifiers: *Comparative law.

All around the world water law seems to be in a state of flux. In recent years a number of countries have revised their laws or enacted water codes to fill a vacuum in their law. A study of these laws discloses that several of them bear a resemblance to western American prior appropriation, incorporating many of its features. The needs behind these newer laws differ from country to country. This comparative study of the extent to which laws arising from such different origins resemble each other emphasizes: (1) England; (2) America; (3) Chile; (4) Israel; and (5) various African nations. It is concluded that western American prior appropriation may offer the most capacity for adaptation and growth in developing nations. Its mechanism of state control over the initiation of development is evolving into an instrument for state planning and the protection of recreation and natural environment. It is flexible enough to deal with the different problems of groundwater and the different conditions of humid areas. Many of its features seem to have universal appeal and application. (See also W70-07095). (Marsee-Florida)
W70-07098

REGULATING GROUNDWATER IN HUMID ZONES,
For primary bibliographic entry see Field 04B.
W70-07099

RELATIONSHIPS BETWEEN WATER QUALITY AND WATER RIGHTS,
For primary bibliographic entry see Field 05G.
W70-07100

REGIONAL WATER QUALITY MANAGEMENT AND CONTROL,
Corwin W. Johnson.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 83-95, 1970. 13 p, 34 ref.

Descriptors: *Water quality control, *Regions, *Planning, *Management, Administration, Water pollution control, Water pollution treatment, Economics, Legislation, State governments, Multipurpose projects, Water resources development, River basin development, Delaware River Basin Commission, Administrative agencies, Local governments, Treatment facilities, Interstate commissions, River basins, Control systems.

A comprehensive, regional approach to water resources development planning, in terms of entire river basins or major portions thereof, is necessary for effective water quality control. Local solutions are often ineffective because of inadequate treatment facilities and lack of control of the entire problem area. The many variables inherent in any water management effort necessitate the creation of regional water quality control authorities with broad powers to plan for and effectuate an integrated system of water quality management. The trend may be toward making the region the standard basis for both regulation of water quality and disposition of wastes. At present the Delaware River Basin Commission is the only interstate agency qualified to implement a comprehensive regional quality control system. There is no state river basin agency engaged in a truly comprehensive quality management program, although river authorities in Texas and regional authorities in California are beginning to play a more active role in this area. Whether interstate or intrastate, such regional authorities need rule-making and enforcement powers to deal with the water quality problem, especially in metropolitan regions. (See also W70-07095). (Caldwell-Florida)
W70-07101

FLOOD PLAIN MANAGEMENT,
Earl B. Schurtz.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 96-111, 1970. 16 p, 99 ref.

Descriptors: *Flood control, *Flood plains, *Land management, Flood plain insurance, Flood plain zoning, River basin development, Watershed management, Federal government, Planning, Programs, Risks, Water injury, Flood damage, Flood protection, Economic impact, Riparian rights, Land use, Legal aspects, Legislation.

Floods continue to be a significant national problem and flood damage increases each year. Several new methods have been proposed to deal with the problem. Flood plain insurance encourages local governments to prevent unwise use of flood plains, reducing the exposure of property to floods and makes available coverage otherwise non-existent. Executive agencies have been ordered to initiate flood control and prevention measures. State and local governments are passing new legislation regulating flood plain occupancy and use. At common law, courts could act only to prevent or provide redress for acts causing flood damage to others. Flood waters were not dealt with as diffused surface waters but as part of the overflowing stream. The central issue in cases arising from flood plain legislation is the extent of the government's police power. Local governments have generally been accorded wide discretion by the courts in regulating uses of land in flood plains. Zoning, building codes, and establishment of encroachment lines have all been upheld. Restrictions upon land use, however, must be reasonable and not arbitrary. (See also W70-07102). (Caldwell-Florida)
W70-07102

NEW SMALL LAKE LAW--OPEN SPACE AND RECREATION VERSUS FILLING AND BUILDING,
R. W. Johnson, and G. R. Morry.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 112-135, 1970. 24 p, 69 ref.

Descriptors: *Cities, *Landfill, *Buildings, *Lakes, Urbanization, Legal aspects, Zoning, Condemna-

tion, Washington, Riparian rights, Navigable waters, Noninavigable waters, Ownership of beds, Easements, Scenic easements, Reasonable use, City planning, Community development, Land use, Urban sociology, Social aspects, Judicial decisions, Legislation, Public rights, Lake shores.
Identifiers: *Urban lakes.

The lack of adequate open spaces in the metropolitan areas of the nation is tragic. Even in those communities where small lakes provide such space, a steady encroachment of fills and buildings pushes further into the water. Law has been slow to develop for the control of this phenomenon. This paper deals with this small problem primarily in those jurisdictions which have recognized a riparian right of common use over the entire surface of the lake. Various methods which might be used to control fill and building on lake beds include the following: (1) the reasonableness test as stated in the riparian rights doctrine; (2) the riparian-right versus no-riparian-right test applied by the Washington Supreme Court in Bach v Sarich, 445 P2d 648 (1968); (3) zoning; (4) public ownership of lake beds; (5) public ownership of scenic easements over the surface of the water; (6) private agreements among riparian owners; and (7) condemnation. Advantages and disadvantages of each method are considered. Also discussed is the control of fill and building on navigable waters. The article concludes that a combination of the various control methods is necessary. (See also W70-07103). (Marsee-Florida)
W70-07103

A REVIEW OF THE TEXAS WATER PLAN: ISSUES AND ATTITUDES,
Comer Clay.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 160-172, 1970. 13 p, 49 ref.

Descriptors: *Texas, *Political aspects, *Water resources development, *Water supply, Administration, Administrative agencies, Costs, Financial feasibility, Financing, Water quality control, Water demand, Reclamation states, Southwest U.S., Political constraints, Surveys, Desalination plants, Multiple-purpose projects, Water conveyance, Water costs, Water delivery, Water requirements, Water shortage.

The state of Texas is presently faced with a water crisis that it is attempting to solve with an ambitious and far-reaching scheme to provide water for Texas for the next fifty years--The Texas Water Plan. The future of water in Texas depends greatly upon the political success of this plan. A recognition of the importance of this political factor has precipitated this study. Over 455 officials and citizens of Texas and New Mexico have been surveyed for their opinions and attitudes toward the Plan. Five major issues related to the Plan are discussed: (1) the need for additional water in Texas; (2) the need for water quality as well as water quantity protections; (3) possible sources from which to obtain additional water; (4) the form and organization of an administrative body to implement the water program; (5) costs and methods of financing the Plan. (See also W70-07095). (Marsee-Florida)
W70-07104

PUBLIC RIGHTS IN PUBLIC RESOURCES: THE CITIZEN'S ROLE IN CONSERVATION AND DEVELOPMENT,
J. L. Sax.
Contemporary Developments in Water Law, Water Resources Symposium, Vol 4, p 136-159, 1970. 24 p, 90 ref.

Descriptors: *Public rights, *Federal government, *Administrative agencies, *Natural resources, Conservation, Adjudication procedure, Judicial decisions, Legislation, Water law, Administration, Jurisdiction, Federal jurisdiction, Regulation, Water resources development, Legal aspects, Environment.

That the public has legally enforceable rights in natural resources is hardly a novel proposition. What is novel is the growing tendency for such rights to be asserted not by governmental agencies on behalf of the people, but by citizen groups, frequently against the very governmental agencies which are supposed to protect the public interest. This article concentrates upon the assertion of these rights at the federal level only: claims against federal agencies and the opportunity for litigation in the federal courts. Ironically, case law relating to citizen's rights in public resources has evolved not out of governmental indifference to environmental quality, but out of an abundance of legislative enactments creating such rights. Where environmental mandates to administrative agencies are ignored, may the citizen enforce that mandate as against the agency. Numerous judicial decisions are discussed as examples in this area. Consideration is given to: (1) issues of the citizen's standing to sue; (2) whether a general statutory mandate creates a public right; (3) governmental agencies' immunity to suit; (4) review of administrative decisions; and (5) the amount in controversy as a bar to federal court access. (See also W70-07095). (Marsee-Florida)
W70-07105

LEWALLEN V MAYS (BOUNDARY DISPUTES BETWEEN OPPOSITE RIPARIAN OWNERS).
95 SW2d 1125-1129 (Ky 1936).

Descriptors: *Kentucky, *Boundaries (Property), *Boundary disputes, *Streams, Surveys, Land tenure, Land use, Bench marks, Bank erosion, Legal aspects, Judicial decisions, Riparian land, Farms, Structures, Real property, Water law.

A dispute arose as to whether the words in plaintiff's and defendant's deeds should be interpreted to call for a straight line boundary, or one running with the meanders of a creek. The court said that in any case of possible conflict, language calling for a specific, straight line boundary of known distance and direction must prevail over general language indicating the creek as boundary. The court held that the straight line boundary conformed to the original patent from the sovereign and was the correct one. The court further found that the plaintiff, who had argued for the straight line boundary, had adversely possessed the land in dispute for many years, treating the straight line as the true boundary of the property. (Caldwell-Florida)
W70-07107

HORTON V SHACKLETT (EASEMENT TO A SPRING).
95 SW2d 939-938 (Tenn Ct App 1936).

Descriptors: *Tennessee, *Easements, *Springs, *Water supply, Access routes, Water utilization, Remedies, Damages, Spring waters, Water holes, Consumptive use, Potable water, Prescriptive rights, Water rights, Water consumption, Legal aspects, Water sources, Groundwater basins, Livestock, Judicial decisions.

Defendants fenced in a spring from which plaintiffs had been accustomed to drawing water. The defendants conceded plaintiffs' easement in the spring, but claimed that they had constructed a basin outside the fence and that this was the one plaintiffs must use. The plaintiffs claimed also that their original easement included the right to drive livestock over defendants' land. The court held that the plaintiffs were entitled to use the waters in the original spring basin, and ordered defendants to construct gates in the fence. However, it was also held that plaintiffs' easement did not include the right to drive livestock over defendants' land to the spring. The court reasoned that such an easement should be limitied to uses reasonably necessary and convenient and should avoid burdens on the servient estate. (Caldwell-Florida)
W70-07108

KIRK V KENNEDY (SOVEREIGN IMMUNITY PLEA BY STATE AGENCY IN QUIET TITLE ACTION).
231 So 2d 246-249 (2d D C A Fla 1970).

Descriptors: *Florida, *Accretion (Legal aspects), *Beaches, *Boundary disputes, Land tenure, Legal aspects, Judicial decisions, State governments, Administrative agencies, Beach erosion, Boundaries (Property), Jurisdiction, Shores.

Several landowners brought suit against the trustees of the State Internal Improvement Fund to quiet title to beach property which had accreted in front of and appurtenant to the landowners' property. Although originally alleging title to the property in themselves, the trustees filed a motion to dismiss the suit on the grounds of sovereign immunity. The landowners argued that the participation by the trustees in the action, affirmatively alleging title in themselves, acted as a waiver of sovereign immunity. The court held that immunity had not been waived by the trustees, as the earlier pleading had been completely withdrawn at the time of the motion to dismiss presently under consideration. The concurring opinion emphasized the scope of the problem of title to accreted beach property due to the nature of Floridas' coastline, and urged legislation authorizing quiet title suits against the trustees. (Caldwell-Florida)
W70-07111

WOOD V WILLIAMS (CONTRACT RIGHTS TO THE USE OF WATER LINES).
184 SW2d 799-801 (Ky 1945).

Descriptors: *Kentucky, *Easements, *Prescriptive right, *Water contracts, Boundaries (Property), Contracts, Judicial decisions, Legal aspects, Local governments, Preferences (Water rights), Proprietory power, Relative rights, Water rights, Pipes, Piping systems (Mechanical), Remedies.

Plaintiff and defendant owned adjoining property purchased from a common owner. The prior owner's residence was on plaintiff's property, and the prior owner had constructed a private water line through defendant's property from the residence to the main water line. Defendant purchased his tract and connected his residence with the private line. Later plaintiff purchased his tract, and in seeking to obtain water service for his residence found that the city would not service both residences through the same line. The city agreed to provide such service only if all the water so used would be paid for by defendant. All parties signed a contract to that effect, which contract also stated that either the city or defendant could require plaintiff to install his own lines if they so desired. Plaintiff sued to enjoin defendant from exercising that option on the ground that he had an easement by prescription over defendant's property. The court held that plaintiff waived whatever prescriptive right he had when he entered into the contract with defendant, since at that time plaintiff's use of the water line became permissive. (Clarke-Florida)
W70-07114

CITY OF HARRODSBURG V CUNNINGHAM (ABANDONMENT OF PRESCRIPTIVE EASEMENTS).
184 SW2d 357-361 (Ky 1945).

Descriptors: *Kentucky, *Easements, *Prescriptive rights, *Dams, Judicial decisions, Legal aspects, Land tenure, Land use, Real property, Boundaries (Property), Proprietary power, Relative rights, Reservoirs, Riparian rights, Water rights, Backwater, Water supply, Flooding, Flood damage, Floodwater.
Identifiers: *Abandonment.

Plaintiff city purchased land for the purpose of damming a stream and creating a water supply reservoir. There already existed across the stream a dam which the owner's grantor had built to operate

a grist mill. The dam had caused water to back up 1.5 miles and had flooded the land belonging to defendant's grantor for such a length of time that a prescriptive right to such flooding arose and was not contested. Some 18 years before the litigation, however, the owner of the dam, plaintiff's vendor, had partially removed it, allowing the stream to flow freely. He admitted at trial that he had had no intention of rebuilding the dam. Plaintiff sued for a declaration of the rights of the parties. The court found the law to be well settled that an easement may be lost by abandonment. In the case of an easement by grant, nonuse alone is never enough to constitute abandonment. In addition thereto, there must be some act by an adverse party, acquiesced in by the owner of an easement, or attendant facts which indicate an intention on the part of the owner to abandon it. Where the easement is prescriptive, however, long, continued nonuse of it raises the presumption of abandonment. Here the nonuse of the prescriptive easement for 18 years, coupled with the owner's act of removing the dam, clearly indicated an intention to abandon the easement. (Clarke-Florida)
W70-07115

CLARK V TILTON (RIGHT TO USE WATER FROM PRIVATE WATER MAIN).

148 SW2d 649-651 (Ark 1944).

Descriptors: *Arkansas, *Water supply, *Water contracts, *Water users, Conduits, Relative rights, Water utilization, Water consumption, Measurement, Conveyance structures, Closed conduits, Water conveyance, Legal aspects, Water rights, Judicial decisions, Reasonable use, Water works, Water permits, Water sources, Hydrants, Pipes.

Several persons joined together to construct a private water line. Defendants purchased a portion of the property which had belonged to one of the original owners and made a new connection onto the line. Plaintiffs, other owners of the line, sought to force severance of the connection. The court conceded that private landowners could construct a private waterline and prevent others from taking water from it. However, the court found no evidence of any intent to restrict use of the line only to the original owners and held that defendants had acquired the right from their grantor to connect onto the line. As the water used by defendants had been charged to another owner's meter, the case was remanded for a determination of the amount owed by defendants to that owner. The court also ordered a meter installed on defendants' connection. (Caldwell-Florida)
W70-07117

INGRAM V GREAT LAKES PIPE LINE CO (DESTRUCTION OF SPRING BY BLASTING)
153 SW2d 547-555 (Mo Ct App 1941).

Descriptors: *Missouri, *Damages, *Springs, *Excavation, Easements, Contracts, Jurisdiction, Legal aspects, Overlying proprietor, Water rights, Confined water, Groundwater, Water supply, Water demand, Fouling, Fractures (Geology), Cracking, Pipelines, Ditches, Rock mechanics, Right-or-way, Judicial decisions.
Identifiers: *Blasting.

Plaintiff executed to defendant pipe line company, for the purpose of laying pipe lines, an easement over her farm land. A natural spring, which provided water for plaintiff's livestock, was located not far from defendant's right-of-way. Despite plaintiff's warnings about the spring, defendant employed dynamite to excavate a layer of thick rock encountered in the right-of-way. After the blasting, the spring disappeared. Plaintiff sued for the difference in the value of the land and for the loss of the spring. Defendant argued that plaintiff had not conclusively proved that the blasting caused the spring to dry up, that it was impossible for the blasting to have such an effect and that, in fact, a severe drought caused the drying up of the spring. The court held that, considering the expert testimony and other evidence on both sides, the jury was warranted in finding that the stream dried as a result of the blasting. The court further held, however, that as a matter of law, plaintiff was not entitled to damages both for the depreciated value of her property and the loss of the spring. Damages for depreciated property value was the correct measure. (Clarke-Florida)
W70-07118

STEPHAN V KENTUCKY VALLEY DISTILLING CO (RIGHT TO USE SPRING WATERS).

122 SW2d 493-498 (Ky 1938).

Descriptors: *Kentucky, *Springs, *Spring waters, *Usufructuary right, Water utilization, Land tenure, Competing uses, Access routes, Easements, Legal aspects, Water rights, Relative rights, Water supply, Legislation, Judicial decisions, Water allocation (Policy), Water sources, Water demand.

A common vendor of plaintiff and defendant sold the plaintiff a portion of the vendor's tract on which was located two springs. The vendor expressly retained the right to use the spring waters. Through mesne conveyances, defendant gained title to the portion originally retained by the common vendor, and claimed the vendor's right to use the spring waters. The court held that the terms of plaintiff's deed were sufficient to vest the right to use the spring waters in the vendor and that this right was properly conveyed to defendant. Plaintiff claimed that the commom vendor and defendant's predecessors in title had abandoned the right through non-use. The court rejected this claim. The court found that plaintiff was estopped from seeking to prevent defendant's use of the water as he had stood by and watched defendant construct an expensive distilling plant in reliance upon the use of the springs. Although the plaintiff's deed only referred to 'the spring', this was construed to refer to both springs as a single source of spring waters. (Caldwell-Florida)
W70-07121

KELLY V CITY OF CAPE GIRADEAU (REMEDIES FOR CITY'S FAILURE TO COMPLY WITH INJUNCTION TO ABATE NUISANCE).
89 SW2d 693-698 (Mo Ct App 1936).

Descriptors: *Missouri, *Abatement, *Flooding, *Remedies, Cities, Flood damage, Judicial decisions, Legal aspects, Drainage, Drains, Outlets.
Identifiers: Injunctions, Nuisances.

In 1919 plaintiff obtained an injunction ordering the defendant city to abate the nuisance of flood waters which regularly collected on plaintiff's property. Upon failure of defendant to provide satisfactory drainage facilities for the property, plaintiff over the years instituted a series of damage suits against the city. In the present case, plaintiff sought to force the city officials to comply with the order. The court held that as the present officials were still bound by the original decree, the action necessarily was one for contempt. The original decree had not been devitalized by the state 10 year statute of limitation for execution of judgements, as the statute only applied to money judgments. The original decree was held insufficient to sustain and action for contempt, and plaintiff's appeal was dismissed. (Caldwell-Florida)
W70-07124

RUGGLES V DANDISON (DISPUTED RIPARIAN RIGHTS TO THE USE OF A LAKE).

279 NW 851-853 (Mich 1938).

Descriptors: *Michigan, *Boundary disputes, *Riparian land, *Prescriptive rights, Boundaries (Property), Judicial decisions, Land tenure, Legal aspects, Riparian rights, Riparian waters, Usufructuary right, Water rights, Banks, Water utilization, Lakes, High water mark, Low water mark, Overflow, Wetlands, Remedies, Barriers, Water levels, Water level fluctuations.

Plaintiff and defendant owned adjoining land. A lake on defendant's land was located fairly close to the boundary between such land and plaintiff's land. In periods of unusually high water, water from the lake would cross onto plaintiff's land. Otherwise plaintiff's land closest to the lake was merely boggy. Defendant built a fence along the boundary which prevented plaintiff's access to the lake. Plaintiff sued to enjoin the maintenance of the fence on the grounds that he was a riparian owner or, in the alternative, that he had a prescriptive right to the use of the lake. The court held that riparian ownership was a question of fact, and the evidence here indicated that the natural condition of the lake was not such that it adjoined plaintiff's property. The court further held that plaintiff's use of the lake had always been at the sufferance of defendant and not open, notorious and hostile for the statutory period of time required to give rise to a prescriptive right. (Clarke-Florida)
W70-07126

LAKELANDS INC V CHIPPEWA AND FLAMBEAU IMPROVEMENT CO (BOUNDARY DISPUTES CAUSED BY ERROR IN ORIGINAL GOVERNMENT SURVEY OF LAKE FRONT PROPERTY).
295 NW 919-926 (Wis 1941).

Descriptors: *Wisconsin, *Boundary disputes, *Surveys, *Lakes, Land tenure, Mapping, Jurisdiction, Meanders, Boundaries (Property), Shores, Legal aspects, Judicial decisions, Costs, Measurement, Administrative agencies, Federal government, Relative rights, Allotments, Riparian land, Water levels.

Plaintiff, the defendant's grantee, found one llg in possession of part of the lake-shore property which was the subject of a land sale to plaintiff. llg appealed to the federal government for a resurvey of the area, claiming that the surveyed meander line of the lake boundary did not reflect the true line of the lakeshore. A resurvey was undertaken and the disputed property awarded to llg by the federal government, whereupon plaintiff sued defendant, his grantor, for breach of warranty of title. The court held that the federal government had no right to reallocate ownership of parcels of land by resurveying the area, since the original error was not large enough to constitute a fraud on the government. The meander line shown on the plat of the area was held not to indicate boundaries, but to indicate the approximate acreage of the respective lots. The true boundaries of the lots, the court held, were to be determined by running the original boundary lines down to the point where they intersected the lakes actual boundary. The warranties in defendant's deed to plaintiff were thus not breached because the federal government's action contravening plaintiff's title was invalid. (Caldwell-Florida)
W70-07127

SWARTZ V SHERSTON (RIPARIAN RIGHTS: LAKE FRONTAGE).
300 NW 148-151 (Mich 1941).

Descriptors: *Michigan, *Boundaries (Property), *Prescriptive rights, *Riparian rights, Ownership of beds, Boundary disputes, Easements, Judicial decisions, Legal aspects, Proprietory power, Relative rights, Riparian land, Riparian waters, Beds, Lake beds, Water rights, Watercourses (Legal), Lakes, Recreation facilities, Piers.

Plaintiff and defendant were adjoining landowners whose properties abutted a large inland lake. The section line dividing the properties ran through a small portion of the north end of the lake giving defendant very little lake frontage. Both parties

rented boats to the public and operated beach facilities. From time to time plaintiff allowed defendant to anchor a diving dock and slide on the water over his submerged land. Disputes between the parties as to the use of the lake caused plaintiff to commence construction of a fence along the section line across the lake. Defendent sued to enjoin such construction, which would prevent his boats from using the lake. Plaintiff cross-billed, seeking to enjoin defendant from anchoring his dock and slide over plaintiff's submerged land. Defendant claimed a prescriptive right thereto by adverse possession. In the first instance, the court found the law to be well settled that several riparian owners to an inland lake may use the surface of the whole lake for boating and fishing, so far as not to interfere with the reasonable use of the waters by other riparian owners. Secondly, the court held that permissive use by defendant of plaintiff's submerged lands for anchorage could not ripen into a prescriptive right since hostility is the very essence of adverse possession. (Clarke-Florida)
W70-07128

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION, BOULDER CREEK AND SOUTH BOULDER CREEK: VOLUME II - BOULDER METROPOLITAN REGION, COLORADO.
Corps of Engineers, Omaha, Nebr.
For primary bibliographic entry see Field 04A.
W70-06767

FLOOD PLAIN INFORMATION, TUALATIN RIVER AND TRIBUTARIES, WASHINGTON COUNTY, OREGON.
Corps of Engineers, Portland, Oreg.
For primary bibliographic entry see Field 04A.
W70-06773

FLOOD PLAIN INFORMATION ON MAIN STEM AND SOUTH BRANCH BIG TIMBER CREEK IN CAMDEN AND GLOUCESTER COUNTIES, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W70-06777

FLOOD PLAIN INFORMATION, CHRISTINA RIVER, EAST AND WEST BRANCHES, NEWARK, NEW CASTLE COUNTY, DELAWARE.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W70-06781

FLOOD PLAIN INFORMATION OF UMATILLA RIVER IN MISSION - RIVERSIDE AREA NEAR PENDLETON, OREGON.
Corps of Engineers, Walla Walla, Wash.
For primary bibliographic entry see Field 04A.
W70-06785

FLOOD PLAIN INFORMATION, SOUTH FORK EEL RIVER, PHILLIPSVILLE TO GARBERVILLE, HUMBOLDT COUNTY, CALIFORNIA.
Corps of Engineers, San Francisco, Calif.
For primary bibliographic entry see Field 04A.
W70-06786

FLOOD PLAIN INFORMATION, CALLEGUAS CREEK, VENTURA COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W70-06787

FLOOD PLAIN INFORMATION, BARTON, MILL, AND STONE CREEKS, BOUNTIFUL, WEST BOUNTIFUL, AND WOODS CROSS, UTAH.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-06789

REGIONAL PLANNING AND FLOOD PLAIN MANAGEMENT,
Pennsylvania State Planning Board, Harrisburg, Pa.
Irving Hand.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 241-254.

Descriptors: *Flood control, *River basin commissions, *Administrative agencies, *Coordination, *Non-structural alternatives, Interstate compacts.
Identifiers: *Regional planning, *Flood plain management, Basin development plans, *Public information, *Federal-interstate compacts.

The need for regional planning for flood control and flood plain management is reviewed, and an outline of groups and agencies involved in this planning is made. Discussed briefly are the responsibilities of river basin agencies, Federal agencies such as Corp of Engineers and the United States Geological Survey, various state water resources planning programs, and multi-county regional planning agencies organized by their component units of county government. Experience is perceived as indicating a trend toward both structural and non-structural measures used in concert with the protection and management of flood plain areas. A growing number of basin study coordinating committees, comprehensive river basin development surveys, Federal-interstate compacts to implement basin plans and statewide water resource plans are also mentioned. Tools available for planning and flood plain management are considered with the regional planning agency given first attention. Advisory roles of the planning agency are stressed, and plans for future development, public information, and coordination are listed as the most important functions. Specific non-structural measures open to local units of government are listed. Included are: zoining in the flood plain, subdivision regulation, building and construction codes and the official map, public information, outright purchase of land, acquistion of development rights, and easements to preserve open space. (Preckwinkle-Chicago)
W70-06945

COMPREHENSIVE FLOOD PLAIN MANAGEMENT REQUIRES BLENDING OF TECHNOLOGY AND SOCIAL FACTORS,
James E. Goddard.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 233-240, 24 ref.

Descriptors: Technology, Population, *Local governments, Regions, Federal government, Structures, *Environmental effects, Regulations, Economic efficiency, *Data collection.
Identifiers: *Flood plain management, *Comprehensive planning, Economic development.

Population growth and distribution have created flood problems more rapidly than flood control is correcting them. And, at the same time, flood control structures are sometimes counter to overall interests and needs of an area. What is therefore becoming widely recognized is that comprehensive plans based on broad management concepts for all our natural resources is necessary. The need to clarify the term 'flood plain management' and the need for coordinated comprehensive thinking with consideration of all alternatives are discussed. Outlined are basic steps in achieving flood plain management: basic data for officials or individuals with interest in the problem, studies to determine most acceptable flood plain regulations, comprehensive studies including all kinds of applicable alternatives and combinations, and finally the implementation phase. The major objective of wise flood plain management is defined as overall local, regional, and national welfare. With this objective, the necessity for evaluating various concepts such as environmental values or needs for areal economic development and for evaluating alternative engineering and managerial techniques is indicated. Because of increasing complexities involving Federal, State or local governments, attention is given to understanding the responsibilities and relationships of each. Finally, several examples are given of the 'blending' of structures with the economic and social needs at respective sites, again illustrating Local-State-Federal relations. (Preckwinkle-Chicago)
W70-06946

WISCONSIN'S FLOOD PLAIN AND SHORELAND MANAGEMENT PROGRAM,
Wisconsin Dept. of Natural Resources, Madison.
Thomas G. Frangos, and Thomas M. Lee.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 263-275, 3 fig, 11 ref.

Descriptors: *Standards, *State jurisdiction, *Flood plain zoning, *Regulation, Taxes, Topography.
Identifiers: *Flood plain management, *Wisconsin Water Resources Act, *Shoreland management, *Joint state-local action, Public purchase, Sanitary districts.

The need for a flood plain and shoreland management program in Wisconsin is outlined and protection regulations are indicated as potentially serving as an effective resource management tool. The Wisconsin Water Resources Act is discussed. Joint state-local action is aimed for, with state responsibilities, including the establishment of minimum statewide standards for flood plain and shoreland regulations, assistance to communities in the adoption of regulations, and surveillance of the enforcement of the local regulations. Progress toward adoption and implementation of shoreland regulations and management are described. Objectives of the regulations are presented with model ordinances providing for three shoreland land use districts, subdivision regulations, and a sanitary code. Success of implementation is described as impressive overall. In case of delinquency, the state can administer and enforce regulations. The flood plain management program is discussed: Guidance in developing flood plains is the objective, not prohibition. Three parts are identified: evaluation of flooding potential and identification of flood plains; formulation, administration, and enforcement of regulations; and continuous review of flood plain management criteria. Problems of inadequate information or technical help are mentioned in reference to communities faced with flood plain development plans; steps in drafting local regulations with currently available information are suggested. (Preckwinkle-Chicago)
W70-06947

FLOOD PLAIN MANAGEMENT,
For primary bibliographic entry see Field 06E.
W70-07102

6G. Ecologic Impact of Water Development

AN ECOLOGICAL STUDY OF THE TWIN CITIES METROPOLITAN AREA,
Metropolitan Council of the Twin Cities, Minn.
David A. Wallace.
Available from Clearinghouse as PB-185 849, $3.00 in paper copy, $0.65 in microfiche. Twin Cities Metropolitan Council Report, June 1969. 127 p, 41 tab, 83 ref, 3 append.

Descriptors: *Ecology, *Cities, *Urbanization, *Land use, *Planning, Water resources development, Water management (Applied), Land development, Land management, Recreation, Parks, Land classification, Land resources.
Identifiers: Minneapolis and St. Paul (Minn).

An ecological survey was made of the Minneapolis-St. Paul area, Minnesota, to be used in urban planning. Each of the major categories of geology (historical and surficial), physiography, hydrology (ground and surface water), soils, plant ecology, and wildlife habitats (terrestrial and aquatic), are mapped. These major subject areas were searched for attributes of relevance to prospective land uses. Ecological phenomena such as rock types, slopes, rivers, lakes, streams, aquifers, soil types, forest associations, wildlife habitats, and scenic, scientific and historic values, are mapped. These data were related to the major prospective land use groups: Production - including agriculture, forestry wildlife and extractive minerals; Protection - including unique, scarce or vulnerable resources; Recreation - both active and passive; and two categories of Urbanization residential and industrial-commercial. (Knapp-USGS)
W70-06764

BIOTIC REGULATION OF PARTICULATE AND SOLUTION LOSSES FROM A FOREST ECOSYSTEM,
Yale Univ., New Haven, Conn. School of Forestry; and Dartmouth Coll., Hanover, N.H. Dept. of Biological Science.
For primary bibliographic entry see Field 02J.
W70-06778

REPORT ON THE BIOLOGICAL FINDINGS OF THE HUDSON RIVER FISHERIES INVESTIGATIONS, 1965-1968,
Hudson River Technical Committee, Cornwall, N.Y.
Frank T. Carlson, and James A. McCann.
In: Hudson River Fisheries Investigations, 1965-1968, p 6-50, 1969. 45 p, 12 fig, 24 tab, 40 ref, 11 append.

Descriptors: *Pumped storage, *Hudson River, *Environmental effects, *Fisheries, Distribution patterns, Life history studies, Striped bass, Aquatic habitats, Aquatic environment, Aquatic productivity.
Identifiers: Cornwall pumped storage plant (N Y).

A pumped-storage, hydroelectric plant is proposed on the Hudson River at Cornwall, N. Y. The distribution of life stages of fish in the Hudson River estuary which are potentially vulnerable to this plant were determined and the impact of possible losses on their populations was studied. The striped bass was given primary emphasis in the study because it is the only species that is the object of a major fishery and is also known to use the estuary near Cornwall as a spawning and nursery area. Substantial numbers of striped bass eggs and larvae would be drawn into the intake of the proposed plant but, of the total production within the estuary, less than 0.7% of the eggs and 2.9% of the larvae would be vulnerable to removable. Up to 6.2% of the young-of-the-year at Cornwall (in the area of influence of the plant) in late summer would be vulnerable to the plant, but this fraction would fluctuate and generally decrease because of increased size of the fish. The operation of the Cornwall plant alone would have negligible effects on the fisheries of striped bass and other species occurring in the estuary. The cumulative effect of operation of additional plants requiring large volumes of water, however, could significantly reduce the production of fish in the river. (Knapp-USGS)
W70-07024

ENVIRONMENTAL EFFECTS OF IRRIGATION IN THE CENTRAL VALLEY OF ARIZONA,
Arizona Univ., Tucson. Dept. of Agricultural Engineering; and Arizona Univ., Tucson. Dept. of Agricultural Economics.
Wayne Clyma, and Robert A. Young.
American Society of Civil Engineers, National Meeting on Environmental Engineering, Chattanooga, Tennessee, May 13-17 1968, Preprint. 28 p, 6 fig, 3 tab, 19 ref.

Descriptors: *Arizona, *Environmental effects, *Irrigation effects, *Water supply, *Water resources development, Irrigation, Irrigation water, Economics, Economic impact, Environment, Deserts, Arid lands, Climate, Vegetation, Groundwater, Groundwater mining, Salinity, Surface water, Water utilization, Water resources, Water transfer, Water quality, Urbanization, Industrial water, Social impact, Social change, Rural areas, Human population, History, Desert Land Act, Land subsidence.
Identifiers: *Irrigated agriculture, Salt River Project, Central Valley (Ariz).

Irrigation has modified the environment of the Central Valley of Arizona for the past 2500 years, beginning with the irrigation systems of the Hohokam Indians. Modification of the physical environment has included changes in climate, groundwater, surface water and vegetation. The social environment has been changed from a rural economy to an urban industrial economic system. Present and future problems related to irrigation in the area are discussed. Some of the problems are water demand, land subsidence, salinity, groundwater management, and allocation of Colorado River water. Solutions to some of these problems are suggested. (Carr-Arizona)
W70-07053

07. RESOURCES DATA

7A. Network Design

FLOOD COMPUTATIONS FOR SUBURBS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
Brian M. Reich.
Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), p 276-294, 11 fig, 7 tab, 18 ref.

Descriptors: *Urbanization, *Hydrographs, *Parametric hydrology, *Flooding, *Discharge (Water), *Routing, *Inflow, *Storms, Flood control, Multiple purpose.
Identifiers: *McSparran hydrograph, *Reich hydrograph, *Soil Conservation Service hydrograph, *Johns Hopkins hydrograph.

Although the notion of multiple use of land and water has reached the planning of suburban communities, the necessary flood hydrographs for minimizing cost-benefit ratios have been lacking. Techniques are available for rural watersheds and highly urban areas but not for suburbs. Therefore, three rural methods and one urban procedure were modified for use on three suburban watersheds in southeastern Pennsylvania. These methods were: McSparran's Pennsylvania Synthetic Hydrograph (M); Reich's Small Rural Synthetic Hydrograph (R); Soil Conservation Service's Curvilinear Hydrograph (S); and Johns Hopkins Urban Inflow Hydrograph (J). Discussion of each method and its development is given along with a table listing the hydrograph parameters of each method. The input to all four methods was rainfall with both reservoir and channel routing involved in this problem. Using the three watersheds with 2, 10, and 100 year storms, five measurements were constructed for each method. These included: inflow hydrographs, outflow at lowest point of combined and routed flood, non-reservoir synthetic hydrograph computed at lowest point, rise times, and scour durations. It is concluded that extrapolation of these four hydrograph methods to suburban design in terms of the 'blue and green' requirements give incompatible results. Radically different structural dimensions would result from each alternative hydrograph procedure. Economic analysis would be correspondingly variable. Finally, the recent stimulus in obtaining hydrologic data for such suburban watersheds should be urgently pursued. (Preckwinkle-Chicago)
W70-06948

MOIRE PATTERN TECHNIQUES IN GROUNDWATER HYDROLOGY,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
R. Allan Freeze.
Water Resources Research, Vol 6, No 2, p 634-641, April 1970. 8 p, 4 fig, 19 ref.

Descriptors: *Groundwater movement, *Model studies, *Analytical techniques, Flow nets, Distribution patterns, Potential flow.
Identifiers: Moire patterns.

The moire pattern technique provides a conceptual or teaching tool that can be applied to problems involving the superposition of potential field solutions. Moire interference also forms the basis of a measurement technique that can be adapted for use with the membrane analogy for groundwater flow. (Knapp-USGS)
W70-07011

7B. Data Acquisition

FLUORESCENT PROBES IN THE DEVELOPMENT OF NEW ANALYTICAL METHODS FOR DETECTION OF WATER POLLUTION,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 05A.
W70-06754

AIRBORNE TECHNIQUES IN CLIMATOLOGY: OASIS EFFECTS ABOVE PRAIRIE SURFACE FEATURES,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
R. M. Holmes.
Inland Waters Branch, Department of Energy, Mines and Resources, Technical Bulletin No 19, Canada, 1969. 28 p, 18 fig, 20 ref.

Descriptors: *Air temperature, *Heat budget, *Evapotranspiration, *Lakes, *Grasslands, Irrigation, Meteorology, Arid lands, Remote sensing, Aircraft, Instrumentation, Surveys, Climatology.
Identifiers: Oasis effect, Alberta (Canada).

A light, single-engine aircraft instrumented to measure air temperature and radiation temperatures of the earth's surface was used successfully to identify several prairie oases. Climatic discontinuities produced by irrigation, agriculture, and prairie lakes were observed. Surface-radiation temperature differences between dry and moist areas were large, and temperature differences of air cooled by passage over these areas were measurable. Under the most extreme conditions measured, air cooling of 3 deg C was noted up to 120 m above Lake Pakowki in southeast Alberta and this cooled air often persisted as far as 10 km downwind from the lee edge of the lake. Surface temperatures of the surrounding land varied greatly and occasionally were 28 deg C warmer than the lake surface. Air temperature profiles obtained near an agriculturally complex area showed the heating and cooling of the atmospheric boundary layer due to surface heating and cooling. Up to 2.0 deg C of heating and 3.0 deg C of cooling of air near the surface was measured as a result of surface characteristics of agricultural and nonagricultural land. (Knapp-USGS)
W70-06766

AN OSMOTIC METHOD FOR STUDYING THE SUCTION/MOISTURE CONTENT RELATIONSHIPS OF POROUS MATERIALS,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 02G.

W70-06768

ROCKY REACH DAM TURBINE RATINGS BY THE CURRENTMETER METHOD,
Beck (R. W.) Associates.
For primary bibliographic entry see Field 08C.
W70-06776

REAL TIME ROUTING OF FLOOD HYDROGRAPHS IN STORM SEWERS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
Garth S. Harris.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY6, Paper 7327, p 1247-1259, June 1970. 13 p, 12 fig, 6 ref, append. FWQA Demonstration Grant.

Descriptors: *Routing, *Flood routing, *Storm runoff, Floods, Open channel flow, Sewers, Unsteady flow, Hydrographs, Time lag, Computer programs, Flood control, Hydraulics, Waves (Water).
Identifiers: Minneapolis-St. Paul (Minn).

A rapid computation of routed flood hydrographs in circular sewers was required for use in the evaluation of the effect of storm flooding in the Minneapolis-St. Paul Interceptor sewers. The method of characteristics is used to provide the accurate assessment of the routed hydrograph but this method requires a comparatively large amount of computer time. The progressive average-lag method is used to carry out the evaluation in real time. The routing constants in the latter method are determined by comparing the results from the former with those of the latter until good agreement is obtained. It has not been possible to determine the routing constants in the latter method analytically. (Knapp-USGS)
W70-06977

EFFECT OF CONCENTRATION GRADIENTS ON THE PERFORMANCE OF A NUCLEAR SEDIMENT CONCENTRATION GAGE,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
J. R. McHenry, N. L. Coleman, J. C. Willis, A. C. Gill, and O. W. Sansom.
Water Resources Research, Vol 6, No 2, p 538-548, April 1970. 11 p, 7 fig, 2 tab, 10 ref.

Descriptors: *Nuclear meters, *Sediment load, *Suspended load, *Gamma rays, Sands, Clays, Radioactivity techniques, Running waters, Sediment discharge.
Identifiers: Nuclear sediment-meter.

A nuclear sediment concentration gage, using the attenuation of 22-kev X rays from cadmium-109 as a function of concentration, was evaluated in a series of laboratory tests conducted in a circulating water tunnel. Sediment concentration measurements were made with the X-ray beam directed up, down, and across the test flume section. Coarse sand, fine sand, and kaolin were used as sediments in concentrations of 100 to 30,000 ppm. The suspensions were passed through the water tunnel at velocities of 0.7 to 3 meters per sec. The response of the nuclear sediment concentration gage was not affected significantly by test position, type or size of particle, or velocity of sediment, but was a function of the total concentration of sediment in the test cross section. (Knapp-USGS)
W70-07001

VELOCITY MEASUREMENT WITH RADIOACTIVE SPHERES,
Illinois Univ., Urbana.
Ben Chie Yen, and Terrence L. McGillivray.
Water Resources Research, Vol 6, No 2, p 609-613, April 1970. 5 p, 2 fig, 11 ref. NSF Grant GY-4212.

Descriptors: *Tracers, *Floats, *Radioactivity techniques, *Tracking techniques, *Current meters, Streamflow, Velocity, Stream gages, Radioisotopes, Instrumentation.
Identifiers: Polystyrene spheres.

The use of radioactive spheres as a flow velocity tracer is feasible. The technique involves trapping a small amount of radioisotope inside a sphere and then measuring the motion of the sphere in the flow. For steady uniform subcritical turbulent flows tested with the Reynolds number up to 13,000 and the flow depth to sphere diameter ratio greater than 1.7 the accuracy of flow velocity measurement with floating tracers is usually within 7%. The accuracy can be improved if the correction for the relative velocity between the fluid and the sphere is made. The advantages of this technique are its simplicity, its relatively small contamination problem, its low cost, and its potential to be used in a wide range of flow conditions. (Knapp-USGS)
W70-07015

STOCHASTIC HYDRODYNAMICS OF SEDIMENT TRANSPORT,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-07023

7C. Evaluation, Processing and Publication

ESTIMATION MONTHLY STREAMFLOWS WITHIN A REGION,
Corps of Engineers, Sacraments, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 04A.
W70-06747

ERROR ANALYSIS OF STREAMFLOW DATA FOR AN ALLUVIAL STREAM,
Geological Survey, Washington, D.C.
D. E. Burkham, and D. R. Dawdy.
Available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price 35 cents. Geological Survey Professional Paper 655-C, p C1-C13, 1970. 13 p, 15 fig, 3 tab, 2 ref.

Descriptors: *Statistical methods, *Stage-discharge relations, *Alluvial channels, *Discharge (Water), Streamflow, Quality control, Hydrologic budget, Discharge coefficients.
Identifiers: Error analysis.

Discharge measurements were used to determine the standard error in computed continuous records of discharge for two streamflow gaging stations on the Gila River. The major source of errors in computed discharge is from poor definition of the stage-discharge relation. The standard errors of computation of discharge for the two stations were determined by randomly choosing a group of discharge measurements for use in rating analysis and using the remaining measurements as a control group. Discharge was computed corresponding to the stage and time of the measurements in the control group. The mean square difference (m-c) between measured and computed discharge was determined for different ranges of flow. The mean square difference (m-c) is the sum of the mean square difference of the measured discharge from true discharge plus the mean square difference of computed discharge from true discharge. The variance was obtained by subtracting the known variance from the mean square difference (m-c). (Knapp-USGS)
W70-06750

SYNTHETIC RAINFALL DATA,
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 02B.
W70-06758

HYDROLOGIC ENGINEERING TECHNIQUES FOR REGIONAL WATER RESOURCES PLANNING,
Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
Augustine J. Fredrich, and Edward F. Hawkins.
Hydrologic Engineering Center Technical Paper No 17, U S Army Corps of Engineers, Davis, California, 1969. 19 p, 5 plate, 12 ref.

Descriptors: *Computer programs, *Water resources development, *Planning, Systems analysis, Model studies, Synthetic hydrology, Data processing, Hydrology, Optimization, Data collections.
Identifiers: Hydrologic engineering.

Only through the use of electronic computers have hydrologic engineers been able to complete the fundamental hydrologic studies that serve as the foundation for most engineering and economic analyses of complex regional water resources developments. Studies recently completed or in progress include development of a regional flood control site screening plan, use of streamflow simulation for planning and operation of the Missouri River mainstem projects, development of an operation plan for the Arkansas-White-Red Rivers reservoir system, standard project flood estimates, flood frequency estimates, and several other projects. (Knapp-USGS)
W70-06780

HYDROGEOLOGY OF THE BEREA AND CUSSEWAGO SANDSTONES IN NORTHEASTERN OHIO,
Geological Survey, Washington, D.C.
Jon L. Rau.
For sale by U S Geological Survey, Wash, D C 20402 - Price $1.00 per set. Geological Survey, Hydrologic Investigations Atlas HA-341, 2 sheets, 1969. Text, 2 fig, 7 map, 3 tab, 14 ref.

Descriptors: *Water resources, *Hydrogeology, *Aquifers, *Ohio, Sandstones, Transmissivity, Specific capacity, Water yield, Permeability, Water quality, Saline water, Brines, Water wells, Water supply, Hydrologic data, Geology, Data collections.
Identifiers: Berea Sandstone (Ohio), Cussewago Sandstone (Ohio).

A 2-sheet hydrologic atlas presents geologic and hydrologic data governing the occurrence and availability of groundwater in the Berea and Cussewago Sandstones of northeastern Ohio. In some localities the Berea and Cussewago are the only important bedrock sources of fresh water. The map scaled 1:250,000, showing areal extent, thickness, and outcrop area of the Berea Sandstone, indicates that the thickness of the sandstone ranges from a few feet near the edge of the outcrop to more than 235 feet at South Amherst, Lorain County. In most areas the thickness of the Berea Sandstone is an important factor in determining the yield of wells. The coefficient of transmissibility of the Berea Sandstone was estimated to range from about 50 to about 30,000 gpd per ft. Because the Cussewago Sandstone is generally more permeable, its wells generally have higher specific capacities than wells in the Berea Sandstone. The coefficient of permeability of the Cussewago Sandstone in Trumbull County ranges from 100 to 300 gpd per sq ft, and averages about 150 gpd per sq ft, where the saturated thickness ranges from 40 to 130 ft. The coefficient of transmissibility averages 13,000 gpd per ft. The average of dissolved solids in the potable water of the Berea Sandstone is 549 mg/l. Farther south (in Medina, Mahoning, and Stark Counties) total dissolved solids may exceed 76,000 mg/l where the Berea Sandstone contains brine. (Knapp-USGS)
W70-06784

MAXIMUM UTILIZATION OF SCARCE DATA IN HYDROLOGIC DESIGN,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard, and A. J. Fredrich.
Paper presented at 2nd CENTO Seminar in Hydrology, Teheran, March 1969 (Proceedings in press). 14 p, 4 ref.

Descriptors: *Computer programs, *Synthetic hydrology, *Streamflow forecasting, Stream gages, Data processing, Hydrologic data, Hydrology, Digital computers, Statistical methods, Statistics, Data collections, Estimating, Mathematical models.
Identifiers: Stream gage networks.

Methods used for extending available hydrologic information in time and space, most of which involved the use of electronic computers, are described. The incremental value of a single streamflow record at the site of a major reservoir can exceeds the cost of the record, even after more than 100 years of record and even for relatively stable streams. The maximum use of hydrologic information in short records for design purposes can be made by an elaborate analysis of the statistical characteristics of recorded streamflows and use of such statistics to generate long sequences. These sequences can be generated at the gaged locations or, through regionalized studies, at ungaged locations. A comprehensive computer program is available in The Hydrologic Engineering Center, U.S. Army Corps of Engineers, Sacramento, California for analyzing monthly streamflow characteristics, estimating missing values of monthly streamflows at short-record stations based on the longer-record stations in the vicinity, and generating any number of streamflow sequences of any length for use in design. (Knapp-USGS)
W70-06788

GROUNDWATER FAVORABILITY AREAS AND SURFICIAL GEOLOGY OF THE LOWER KENNEBEC RIVER BASIN, MAINE,
Geological Survey, Washington, D.C.
Glenn C. Prescott, Jr.
For sale by U S Geologicl Survey, Wash, D C 20402 - Price $0.75. Geological Survey Hydrologic Investigations Atlas HA-337, 1 sheet, 1969. Text, 11 fig, 1 tab, 2 map, 4 ref.

Descriptors: *Water resources, *Groundwater, *Maine, Water wells, Aquifers, Water yield, Water quality, Transmissivity, Hydrogeology, Geology, Hydrologic data, Data collections.
Identifiers: Kennebec River basin (Maine).

This report is one of a series describing the geologic and hydrologic conditions governing the occurrence of groundwater in Maine. These reports are intended to provide information to those wishing to develop water supplies, particularly supplies large enough for public or industrial use, from groundwater sources. The magnitudes of yields that might be expected from properly located and constructed wells of 6 inches or more in diameter are indicated by the map showing groundwater favorability areas and surficial geology. A map, scaled 1:62,500, gives a generalized interpretation of observed geologic and hydrologic data. It provides a logical basis for directing detailed exploration for groundwater. Precipitation for the area averages about 43 inches per year. Of this, about 24 inches runs off in streams, and most of the remainder is evaporated or transpired. Of the water that runs off, perhaps as much as 40% is derived from precipitation that has percolated to the water table and thence moved laterally to the streams. This amounts to an average groundwater discharge of about 0.4 mgd per square mile of drainage area. Bedrock wells range from 26 to 700 ft in depth. The average depth was 135 ft and the median depth was 115 ft. The yields of bedrock wells range from 0 to 67 gpm. The average yield is 11 gpm and the median yield is 7 gpm. The groundwater in the area is suitable for most purposes. It is generally low in dissolved solids and free from most constituents that would limit its usefulness. In local areas or in individual wells the water may contain undesirable concentrations of iron, manganese, chloride, or nitrate, or may be exceptionally hard. (Knapp-USGS)
W70-06790

GROUNDWATER RESOURCES OF CRAVEN COUNTY, NORTH CAROLINA,
Geological Survey, Washington, D.C.
Edwin O. Floyd.
For sale by U S Geological Survey, Wash, D C 20402 - Price $1.00. Geological Survey Hydrologic Investigations Atlas HA-343, 2 sheets, 1969. Text, 5 fig, 3 tab, 5 graph, 5 ref.

Descriptors: *Water resources, *Groundwater, *North Carolina, Aquifers, Water yield, Water quality, Water supply, Water wells, Hydrogeology, Stratigraphy, Hydrologic data, Data collections.
Identifiers: Craven County (N C).

The water used in Craven County, North Carolina is obtained entirely from aquifers. The availability and quality of water in the county are discussed in a 2-sheet hydrological atlas consisting of maps, cross sections, graphs, tabulated data, and text. The amount of water pumped annually in the county is about 40-45 mgd, mainly from aquifer 2, a sandy limestone of Eocene and Oligocene ages. Groundwater is hard everywhere in the county, and too salty to be useful in most of the deeper aquifers. Some saline water encroachment has occurred in parts of aquifer 2. (Knapp-USGS)
W70-06791

INTERBASIN DIVERSION OF WATER: AN ANNOTATED BIBLIOGRAPHY,
Texas Tech Univ., Lubbock. Water Resources Center.
George A. Whetstone.
Texas Tech University, Water Resources Center, WRC 70-2, January 1970. 323 p.

Descriptors: *Inter-basin transfers, *Water transfer, *Diversion, *Bibliographies, *Information retrieval, Documentation, Water supply, Water conveyance, Water resources development.

This bibliography was compiled for Water, Inc., an organization interested in the study and advocacy of water importation into the High Plains of New Mexico, Oklahoma, and Texas. It contains 1020 annotated entries on the subject of water transfer between basins. The references, arranged chronologically by years and alphabetically by author within each year, cover the period 1874-1969. There are two indices, one by author and the other by geographical area. The compiler makes no claim that the work is definitive; in fact, a second volume is in preparation. (Carr-Arizona)
W70-06816

DATA PROCESSING IN PHILADELPHIA,
Philadelphia Water Dept., Pa.
For primary bibliographic entry see Field 05D.
W70-06890

MANAGEMENT OF POLLUTION DATA USING MODERN TECHNIQUES,
Minneapolis-St. Paul Sanitary District, Minneapolis, Minn.
For primary bibliographic entry see Field 05D.
W70-06922

A SEMANTIC WATER EXCURSION ON SCIENCE, RESEARCH AND TEACHING,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 10.
W70-06938

ENVIRONMENTAL GEOLOGY AS AN AID TO URBAN AND INDUSTRIAL GROWTH IN NORTHWEST ALABAMA,
Alabama State Geological Survey, Tuscaloosa.
For primary bibliographic entry see Field 06B.
W70-06952

COMPUTER CONTROL OF COMBINED SEWERS,
Minneapolis-St. Paul Sanitary District, Minneapolis, Minn.
For primary bibliographic entry see Field 05G.
W70-06954

MAXIMUM FLOODS IN IOWA,
Geological Survey, Iowa City, Iowa. Water Resources Div.
For primary bibliographic entry see Field 02E.
W70-06986

APPLICATION OF A STATISTICAL ZONATION METHOD TO RESERVOIR EVALUATION AND DIGITIZED-LOG ANALYSIS,
Michigan Univ., Ann Arbor. Dept. of Geology and Mineralogy.
Dan Gill.
American Association of Petroleum Geologists Bulletin, Vol 54, No 5, p 719-729, May 1970. 11 p, 8 fig, 18 ref.

Descriptors: *Data processing, *Borehole geophysics, *Subsurface mapping, *Statistical methods, Computer programs, Hydrologic data, Groundwater, Digital computers, Logging (Recording), Subsurface investigations.
Identifiers: Digital data systems, Geophysical logs.

Geologic data are recorded as one-dimensional functions in which each observation is associated with its position on a continuous and ordered location-reference axis. Distinct subsets (zones) within ordered data sets can be recognized and identified statistically by an analysis of variance procedures. An optimal subdivision is attained if zones are established such that the within-zone variance is minimized and the between-zone variance is maximized. The search for the most suitable boundaries is an iterative procedure in which all possible arrangements into two contiguous zones are considered at each stage. The suitability of each proposed boundary is evaluated by computing a zonation index. Examples representative of situations in subsurface geologic studies are presented to illustrate the method. It has wide application in the automation of digitized-log evaluation. It proved useful as a data-reduction tool in the integration of multiwell information into a three-dimensional picture. The method is general and lends itself to many additional applications in geology and other disciplines. (Knapp-USGS)
W70-06991

FLOODS IN SYMERTON QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Washington, D.C.
Howard E. Allen, Allen W. Noehre, and Leland D. Hauth.
For sale by U. S. Geological Survey, Wash, D C 20402 - Price 75 cents. Geological Survey Hydrologic Investigations Atlas HA-305, 1 sheet, 1970. Text, 11 fig, 2 tab, 1 map, 4 ref.

Descriptors: *Floods, *Illinois, Maps, Stage-discharge relations, Frequency analysis, Streamflow, Flood plains, Flood control, Stream gages, Profiles.
Identifiers: Symerton (Ill.).

This report presents hydrologic data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Symerton quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving existing flood problems and for formulating effective flood-plain regulations that will minimize the creation of new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facilities, developing recreational areas, and managing surface water in relation to groundwater resources. The areas inundated by floods along streams in the Symerton 7 1/2-minute quadrangle are delineated on a topographic map. The relation between discharge and frequency is shown by graphs. The general relation between recurrence interval and flood height at the gaging station on Hickory Creek at Joliet is tabulated. Profiles of the water surface, based primarily on elevations of marks left by floods of July 1957 and December 1965 are shown. (Knapp-USGS)
W70-07017

MAPPING FOR CHANGING ENVIRONMENT,
Geological Survey, Arlington, Va. Topographic Div.
Morris M. Thompson.
ASCE Proceedings, Journal of the Surveying and Mapping Division, Vol 95, No SU 1, Paper 6818, p 35-48, October 1969. 14 p, 15 fig, 14 ref.

Descriptors: *Maps, *Mapping, *Topography, *Automation, Data processing, Computers, Photogrammetry, Aerial photography, Remote sensing, Urbanization, Surveying instruments, Instrumentation, Terrain analysis, Computers, Natural resources.
Identifiers: Topographic maps.

Topographic maps provide a vital inventory of man's physical environment. To meet the demand for maps, several approaches can be considered: increased expenditures for mapping, concentration on new mapping, concentration on map revision, or development of better techniques. The only feasible approach today is improvement of techniques. Several avenues for advancing map technology are cited, such as the use of airborne electronic systems for field surveys, the application of new photogrammetric systems for control extension and map compilation, the automation of various cartographic operations and the establishment of computer shortcuts. The orthophotomap is a new kind of map presentation that gives a better inventory of certain environmental situations. To solve the mapping problem in rapidly changing areas, a new 'interim-revision' system provides a means of updating maps at greatly reduced cost. (Knapp-USGS)
W70-07019

WATER RESOURCES OF THE PINE RIVER BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Washington, D.C.
R. L. Knutilla.
For sale by U. S. Geological Survey, Wash, D C, 20402 - Price $0.75 cents. Geological Survey Hydrologic Investigations Atlas HA-327, 1 sheet, 1969. Text, 3 fig, 7 map, 2 tab.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Michigan, Water wells, Streamflow, Water yield, Water quality, Aquifers, Water supply, Base flow.
Identifiers: Pine River basin (Mich.).

The water resources of the Pine River basin, southeastern Michigan are described in a 1-sheet hydrological atlas consisting of 2 maps scaled 1:250,000, and 6 maps scaled about 4 miles to 1 inch. Tables, stream gradient profiles, and water quality graphs are also included. The land surface of the Pine River basin, an area of 194 sq mi, is a relatively flat or gently undulating northwest to southeast trending glacial lake plain. Drainage is not well developed in the basin. Many stream courses are poorly defined, having cut only from 3 to 10 ft below the adjacent plain. For this reason, ditches and drains are necessary to effectively drain parts of the basin. There are a few small scattered ponds, but no lakes within the basin. Water can be obtained almost anywhere in the basin from wells completed in glacial deposits. Surface water in the basin is of a chemical quality generally suitable for most uses. Water from shallow wells, as indicated from analyses in adjacent basins and reflected in the quality of stream waters, is of the calcium magnesium bicarbonate type, but water from wells at depths greater than about 75 ft are of the sodium bicarbonate or sodium chloride type. (Knapp-USGS)
W70-07028

08. ENGINEERING WORKS

8A. Structures

BANK STABILIZATION IN SUSQUEHANNA RIVER BASIN,
Corps of Engineers, Baltimore, Md. Basin Planning Branch.
For primary bibliographic entry see Field 04D.
W70-06733

EROSION AND RIPRAP REQUIREMENTS AT CULVERT AND STORM-DRAIN OUTLETS,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
J. P. Bohan.
Corps Engineers Waterways Experiment Station Research Report H-70-2, January 1970. 18 p, 8 fig, 20 plate, 4 photo, 8 tab, 11 ref.

Descriptors: *Scour, *Culverts, *Outlet works, *Riprap, Hydraulics, Erosion, Bank protection, Engineering structures, Erosion control, Model studies, Hydraulic models.
Identifiers: Riprap design.

Experiments were conducted to determine the characteristics of scour below a culvert outlet discharging onto a horizontal blanket of cohesionless soil and to develop guidance for designing riprap protection downstream of culvert and storm-drain outlets. Scour holes, produced by the discharge of various flows of several durations through culverts of various shapes and sizes, were observed and contoured. These data were obtained for several tailwater conditions and were used to develop generalized expressions describing the maximum length, width, depth, and volume of scour as functions of the flow duration and the Froude number of flow at the culvert outlet. Dimensionless scour profiles and cross sections, for low and high tailwater conditions, were also developed. Riprap blankets of various configurations and stone sizes were tested with several culvert sizes and shapes and various tailwater conditions to determine when displacement or failure occurred. The results were used to develop generalized relations to describe the stone size and appropriate blanket configuration required to prevent blanket failure and soil erosion, respectively, at a culvert or storm-drain outfall. (Knapp-USGS)
W70-06753

HYDROGEN SULFIDE DAMAGE TO CONCRETE PIPE,
Seattle Metropolitan Municipality, Wash.
For primary bibliographic entry see Field 05D.
W70-06893

CHICAGO'S SOUTH WATER FILTRATION PLANT.
For primary bibliographic entry see Field 05D.
W70-06919

CHICAGO WATER SYSTEM, A DESCRIPTION OF THE SYSTEM AND ITS SANITARY PROTECTION.
For primary bibliographic entry see Field 05D.
W70-06923

POTENTIAL IMPACT OF TUNNELS ON WATER POLLUTION AND FLOOD CONTROL IN THE CHICAGO AREA,
Metropolitan Sanitary District of Greater Chicago, Ill.
For primary bibliographic entry see Field 05G.
W70-06926

OPTIMUM DESIGN OF COMPLEX WATER RESOURCE PROJECTS,
Rand Water Board, Johannesburg (South Africa).
For primary bibliographic entry see Field 06A.
W70-06980

8B. Hydraulics

MECHANICS OF OPEN-CHANNEL FLOW SYSTEMS,
California Univ., Davis. Dept. of Water Science and Engineering.
Theodor Strelkoff, and Jaime Amorocho.
Available from the Clearinghouse as PB-191 815, $3.00 in paper copy, $0.65 in microfiche. California University Water Resources Center Research Project Technical Completion Report, November 1969. 8 p, 17 ref. OWRR Project No B-037-Calif. (2).

Descriptors: *Open channel flow, *Unsteady flow, *Mathematical models, Hydraulic models, Model studies, Non-uniform flow, Channel morphology, Stage-discharge relations, Canals, Hydraulics, Hydraulic structures.
Identifiers: Open channel flow mechanics.

Accurate and efficient computational procedures were sought for predicting steady and unsteady flows in open-channel systems. A major element of such systems is a long reach of channel containing a flow that may be variable along its length. Such flows can also be variable with time. Prediction of the resulting time-dependent surface profiles was achieved by the use of a number of finite-difference schemes based upon explicit, implicit, and characteristics approaches. The problem of steep fronted waves--bores--arising as the result of sudden, large changes in channel discharge, was studied and a computational technique developed. Experiments corroborate computed results. Flow profiles and discharges coefficients for a series of hydraulic structures--overfalls, gates, and sills were obtained by analytical means; comparison with experiment shows good agreement. A mathematical model of a complete open channel flow system was developed. A comparison of model results with empirical data taken on a portion of the Delta-Mendota Canal showed good agreement. (Knapp-USGS)
W70-06760

REPORT ON REQUIRED FACILITIES FOR REPLENISHING AND PROTECTING GROUNDWATER RESERVES IN THE CENTRAL AND WEST COAST GROUNDWATER BASINS, PART III: DOMINGUEZ GAP BARRIER PROJECT,
Los Angeles County Flood Control District, Calif.
For primary bibliographic entry see Field 04B.
W70-06917

REAL TIME ROUTING OF FLOOD HYDROGRAPHS IN STORM SEWERS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 07B.
W70-06977

A STATISTICAL COMPARISON OF MEANDER PLANFORMS IN THE WABASH BASIN,
Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 04A.
W70-07003

HODOGRAPH SOLUTION OF THE DRAINAGE PROBLEM WITH VERY SMALL DRAIN DIAMETER,
Agricultural Research Council, Cambridge (England). Unit of Soil Physics.
For primary bibliographic entry see Field 04A.
W70-07006

STATISTICAL ROUGHNESS PARAMETER AS INDICATOR OF CHANNEL FLOW RESISTANCE,
Pittsburgh Univ., Pa.
For primary bibliographic entry see Field 02E.
W70-07013

SOME FINITE DIFFERENCE SOLUTIONS FOR THE DISPERSION OF THERMAL SOURCES IN STEADY PRISMATIC FLOW,
Rutgers - The State Univ., New Brunswick, N.J.
For primary bibliographic entry see Field 05B.
W70-07014

SEEPAGE FROM TRAPEZOIDAL CHANNELS,
Uttar Pradesh Irrigation Research Inst., Roorkee (India).
For primary bibliographic entry see Field 04A.
W70-07016

HYDRAULIC DESIGN OF SELF-CLEANING SEWAGE TUNNELS,
Norges Tekniske Hoegskole, Trondheim.
For primary bibliographic entry see Field 05D.
W70-07046

VARIATION OF ALPHA AND BETA VALUES IN A LINED OPEN CHANNEL,
Colorado State Univ., Fort Collins. Coll. of Engineering, and Geological Survey, Fort Collins.
For primary bibliographic entry see Field 02E.
W70-07092

8C. Hydraulic Machinery

ROCKY REACH DAM TURBINE RATINGS BY THE CURRENTMETER METHOD,
Beck (R. W.) Associates.
S. M. Alexander.
Public Utility District No 1, Chelan County, Wenatchee, Wash, Columbia River Turbine Discharge Rating Program Report, December 1969. 63 p, 25 fig, 16 plate, 8 tab, 4 append.

Descriptors: *Current meters, *Discharge (Water), *Hydroelectric plants, *Columbia River, *Washington, Data collections, Hydrologic data, Open channel flow, Closed conduit flow, Stage-discharge relations, Instrumentation, Stream gages, Velocity, Flow measurement, Rotating meters.
Identifiers: Rocky Reach (Wash).

A total of 49 discharge measurements were made in the turbine intakes of the units at the Rocky Reach Project, Columbia River, Washington by the multiple currentmeter method. Simultaneous measurements of spiral case piezometer pressures and of related parameters permitted the evaluation of a calibration equation for the piezometer taps at each unit. Measurements of gross head and generator output were made during the currentmeter measurements to permit determination of a unit performance curve at the test head condition. Simultaneous measurements were made of gross head and power output to provide unit performance curves at the test head. An average unit performance curve was developed for the six units defining the relationship between discharge, power output and gross head. Approximately 75% of all test points fell within 2% of the mean unit performance curves. (Knapp-USGS)
W70-06776

THEORIES AND MEASUREMENTS IN CHARACTERISTIC PROBLEMS OF HYDROSTATIC VANE PUMPS (IN GERMAN).
Technische Hogeschool, Eindhoven (Netherlands).
Peter Wuesthof.
Available from the Clearinghouse as N70-14403, $3.00 in paper copy, $0.65 in microfiche. Ph D. Thesis, Nov 18, 69. 129 p 73 ref.

Descriptors: *Fluid mechanics, *Hydraulic equipment, *Hydrostatic pressure, *Pumps, Impellers, Mechanical properties.
Identifiers: *Vanes.

Although hydraulic vane pumps do not reach comparable pressures and efficiency degrees as piston pumps, their simple construction allows for direct transfer of mechanical energy into hydraulic energy. The development of vane pump families from otherwise unchanged basic units through change of displacement capacity is only possible to a limited degree. Axle inclination difference cannot be extended unlimited in relationship to blade dimension. Only one third of the blade surface is utilized for pressure production during displacement motion whereas two thirds of the vane remain in the motor slit. Vane pumps that exceed the correlation of lift height and blade dimension by a factor of 8 are not practical.
W70-06845

ALTERNATIVES FOR SLUDGE DISPOSAL, METROPOLITAN SEWERAGE SYSTEM,
San Diego Dept. of Utilities, Calif.
For primary bibliographic entry see Field 05E.
W70-06916

MAIN STATION CONTROL,
Louisville Water Co., Ky.
Frank C. Campbell.
November 17, 1969. 10 p, 1 fig, 1 tab.

Descriptors: *Control systems, *Instrumentation, *Remote control, *Automation, *Automatic control, *Waste water treatment, *Pumping, Pumps, Monitoring.
Identifiers: *Louisville Water Plant.

This report outlines the installation and operations of a proposed Main Station Control for the Louisville Water Treatment Plant to provide a central location where all primary pumping units can be controlled and the auxilliary systems monitored. The control will consist of a central panel flanked by control modules for each of six existing primary pumping units. The purpose of the control panel is to consolidate all monitoring and control devices that indicate station operating conditions which are common to each primary electrical pumping unit. There will be a graphic control panel to indicate which primary units are in operation and to show a schematic outline of the station headers and control valves. There will be an alarm section to indicate loss of voltage, open circuit breakers, incorrect header discharge pressure, low clear-well level, flooding, and plant security. The primary electric pumping unit control module will contain an electrical power section, ready systems monitoring, pump operation conditions section and an alarm section. Main station control and instrumentation should increase the dependability of operation. Design flexibility will be built into the system to allow for full automation in the future. The estimated cost of the installation is not available at this time. (Poertner-Chicago)
W70-06924

CHICAGO'S CENTRAL WATER FILTRATION PLANT.
Department of Water and Sewers, Chicago, Ill.; and Department of Public Works, Chicago, Ill.

Report, 1966. 24 p, 26 fig.

Descriptors: *Water treatment, *Water purification, *Filtration, *Filters, *Water supply, *Water works, *Treatment facilities, *Construction, Operations, Monitoring, Data collections, Instrumentation.
Identifiers: *Chicago Water Department.

The operation of Chicago's Central Water Filtration Plant is described. The plant is the world's leader in output. It produces filtered water at a rate of 960 million gallons a day. Located on a 61 acre peninsula on Lake Michigan the plant normally receives raw water through tunnels from intake cribs located in Lake Michigan. A shore intake is also available. The filtration process starts at the north end of the plant where the water is brought in. After passing through 8 screens, the water is pumped to an elevation of 21 feet and flows by gravity through the rest of the processes. Chemicals are added, using the most advanced feeding systems, as the water flows to the mixing basins, then on to the settling basins where 85 to 90 per cent of the impurities are removed by sedimentation, enhanced by alum-floc coagulation. The water is then passed on to the filtration building where the final polishing operation is completed before flowing into clearwells and thence to the filtered water reservoir awaiting distribution. The processes, from start to finish, are monitored, centrally displayed and recorded, supervised, and manually controlled using a centralized complex of special instruments and a computer-data-logger. A closed-system television system is used for making visual checks of strategic points. Information gathered is used to increase efficiency of plant operations. (Poertner-Chicago)
W70-06927

JURISDICTION OF THE FEDERAL POWER COMMISSION OVER NON-POWER WATER USES,
For primary bibliographic entry see Field 06E.
W70-07062

8D. Soil Mechanics

COMPRESSIBILITY AND CRUSHING OF GRANULAR SOIL IN ANISOTROPIC TRIAXIAL COMPRESSION,
California Univ., Los Angeles. Dept. of Engineering.
Kenneth L. Lee, and Iraj Farhoomand.
Canadian Geotechnical Journal, Vol 4, No 1, p 68-99, February 1967. 32 p, 11 fig, 1 tab, 21 ref, discussions. NSF Grant No GK 921.

Descriptors: *Soil mechanics, *Soil strength, Laboratory tests, Compressive strength, Porous media, Filtration, Permeability, Dam construction, Earth materials, Soil compaction, Soil engineering.
Identifiers: Soil crushing strength.

Isotropic and anisotropic triaxial compression tests were performed on a number of sands and gravels. A review was made of the results reported by others. Granular soil is quite compressible under an applied stress. Compression is usually accompanied by a certain amount of particle breakage, and the two phenomena seem to be somewhat related to each other. Coarse soils compress more and show more particle crushing than fine soils. Soils with angular particles compress more and show more particle crushing than soils with rounded particles. Uniform soils compress and crush more than graded soils with the same maximum grain size. Under any particular load, compression and particle crushing continue to increase at an ever-decreasing rate for an indefinite period of time. Although a considerable amount of particle crushing will occur under the stress conditions likely to exist near the base of a large earth dam, data suggest that this crushing will probably not be detrimental to the function of gravel drains or soil filters. (Knapp-USGS)
W70-06800

COASTAL ENGINEERING ASPECTS OF AN AIRPORT IN LAKE MICHIGAN,
Department of Public Works, Chicago, Ill.
Milton Pikarsky.
A paper presented at the Annual and Environmental Meeting of the American Society of Civil Engineers, Chicago, October 13-17, 1969; Meeting Preprint 1065. 20 p.

Descriptors: *Airports, *Dikes, *Lake beds, *Lake Michigan, *Aircraft, *Water values, *Water resources, *Coastal engineering, Hydraulic engineering, Soil engineering, Construction, Construction costs.
Identifiers: *Chicago, *Polder.

The cost, feasibility, and construction aspects of building an Airport in Lake Michigan are

discussed. One proposal is the construction of a circular polder (an acre of lake bottom uncovered by pumping out the water within the confines of a circular dike) about 5 miles in diameter, 11,000 acres in area and centered about 8 miles offshore in Lake Michigan. The circular dike would be about 82,000 ft. long and would require approximately 150,000,000 cubic yards of fill. It was found through field investigations that there are several sites near the lake where the fill could be mined. A lake quarry would satisfy the needs and would also help to reduce costs. The only conventional alternatives to a polder for a lake site are an island or a peninsula. This would require much more fill (1,064 million cubic yards) in addition to the required material for the dike proper. Harza Engineering Company, after completing engineering studies, evaluation of lake bottom borings, and a seismic survey has concluded that the lake airport site is entirely feasible. They estimate that the polder in Lake Michigan would cost approximately $500,000,000. Construction time is estimated to be 5 or 6 years. Chicago is awaiting information from the FAA on air space simulation studies before deciding upon the site for its next airport. (Poertner-Chicago)
W70-06921

8E. Rock Mechanics and Geology

COMPRESSIBILITY AND CRUSHING OF GRANULAR SOIL IN ANISOTROPIC TRIAXIAL COMPRESSION,
California Univ., Los Angeles. Dept. of Engineering.
For primary bibliographic entry see Field 08D.
W70-06800

8H. Rapid Excavation

INGRAM V GREAT LAKES PIPE LINE CO (DESTRUCTION OF SPRING BY BLASTING)
For primary bibliographic entry see Field 06E.
W70-07118

10. SCIENTIFIC AND TECHNICAL INFORMATION

INTERBASIN DIVERSION OF WATER: AN ANNOTATED BIBLIOGRAPHY,
Texas Tech Univ., Lubbock. Water Resources Center.
For primary bibliographic entry see Field 07C.
W70-06816

A SEMANTIC WATER EXCURSION ON SCIENCE, RESEARCH AND TEACHING,
Illinois Univ., Urbana.
Icko Iben.
Proceedings of the Third American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1967, p 603-607, 4 ref.

Descriptors: *Communication, *Water resources, *Information retrieval.

The subject of communication in water resources is considered with reference to the term deontology. This term used by Jeremy Benthen means 'Knowledge of what is right or proper,' 'As an art, it is doing what is fit to be done, as a science, it is knowing what is fit to be done on every occasion.' The author stresses that water men will do what is fit to be done if they know what is fit to be done. Accordingly, the American Water Resources Association has as two if its three stated objectives: the establishment of a common meeting ground for members of the profession; and the collection, organization and dissemination of ideas and information in the field of water resources science and technology. The need for collecting records of action that have been reduced in quantity to archives is discussed. This need is not only directed toward documents of practical value but also toward those with historical value. The American Water Resources Association and the Science Information Service of the Smithsonian Institution are mentioned in this regard along with the American Water Resources Library established at Urbana, Illinois, in 1965. The latter is discussed with some attention paid to procedures and lines of communication with publications such as Hydata, AWRA Bulletin and AWRA News-Letter. Means of collecting literature earlier than 1964 are discussed. Finally, with growing collections, the need for an information center will become more acute. Plans for dealing with this, including the publication of Hydata, are discussed. (Preckwinkle-Chicago)
W70-06938

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W70-07115 06E

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W70-07124 06E

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INFLUENCE OF TEMPERATURE CHANGE ON SPONTANEOUS LOCOMOTOR ACTIVITY AND OXYGEN CONSUMPTION OF ATLANTIC SALMON, SALMO SALAR, ACCLIMATED TO TWO TEMPERATURES,
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W70-06895 05D

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W70-06965 05G

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ACTIVATED CARBON
HIGH QUALITY REUSE WATER BY CHEMICAL-PHYSICAL WASTE WATER TREATMENT,
W70-06882 05D

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 18
SEPTEMBER 15, 1970

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W70-07149 -- W70-07648

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign), single copy price is $3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.

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SELECTED
WATER RESOURCES ABSTRACTS

'A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 18
SEPTEMBER 15, 1970

W70-07149 -- W70-07648

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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Office of Water Resources Research
U.S. Department of the Interior
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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

SOME PROPERTIES OF WATER AT ELEVATED PRESSURES AND TEMPERATURES,
For primary bibliographic entry see Field 02K.
W70-07171

FREEZING TEMPERATURES OF WATER DROPLETS IN EQUILIBRIUM WITH DIFFERENT GASES,
Pennsylvania State Univ., University Park, Pa. Dept. of Meteorology.
For primary bibliographic entry see Field 02B.
W70-07335

02. WATER CYCLE

2A. General

MATHEMATICAL MODELS OF AREA RAINFALL,
State Rivers and Water Supply Commission, Melbourne (Australia).
For primary bibliographic entry see Field 02B.
W70-07175

FLOOD-WAVE FORMATION,
University Coll., Galway (Ireland); and State Rivers and Water Supply Commission, Melbourne (Australia).
J. E. Nash, and J. V. Sutcliffe.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 147-155, 1969. 9 p, 4 fig, 5 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Flood forecasting, Evapotranspiration, Infiltration, Antecedent precipitation, Evaporation, Precipitation excess, Water storage, Optimization, Systems analysis, Probability, Streamflow forecasting.
Identifiers: Flood wave formation.

A mathematical rainfall-runoff model assumes that the catchment, in determining volumes of runoff due to individual rainfall events, is analogous to a vertical stack of horizontal soil layers each of which can contain a certain amount of water at field capacity. Evaporation from the top layer occurs at the potential rate and from the second layer only on exhaustion of the first and then at the potential rate multiplied by a parameter c the value of which is less than unity. On exhaustion of the second layer, evaporation from the third layer occurs at the potential rate multiplied by c squared, and so on. In this way a constant evaporation potential applied to the catchment would reduce the soil-moisture storage in a roughly exponential manner. When the rainfall exceeds the evaporation, a fraction of the excess contributes to generated runoff (output), and of the remainder anything in excess of a threshold value also contributes to generated runoff. The remaining rainfall excess is used in restoring the storages in the several layers to field capacity, beginning with the first and proceeding downwards until the rainfall excess is exhausted or all the layers are at field capacity. Any final excess also contributes to generated runoff. Other models are briefly reviewed. (Knapp-USGS)
W70-07179

MATHEMATICAL MODELLING OF THE RUNOFF PROCESS OF RIVERS WITH COMPOUND ALIMENTATION,
J. M. Denisov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 172-180, 1969. 9 p, 4 fig, 2 ref.

Descriptors: *Streamflow forecasting, *Mathematical models, Snowmelt, Routing, Synthetic hydrology, Simulation analysis, Rainfall-runoff relationships, Computer programs, Model studies, Flood forecasting.
Identifiers: *USSR.

Mathematical models used for runoff forecasting in the USSR are reviewed. The elaboration of mathematical models of river runoff has difficulties including lack of basic data, a considerable noise level, and the uncertainty of the characteristics of water movement in the drainage basin, its depth, and the circumstances of its emergence on to the surface, as well as its routing through the channel. The lack of basic data and the noise-level might cause a model which is theoretically more exact to appear less satisfactory than a rougher one. Modelling should therefore start with simpler schemes. The simplest model of snowmelt runoff on the surface of a mountain drainage basin and some subsequent transformation schemes are described. Weather station observations of daily air temperature, humidity and amount of precipitation serve as basic data for the runoff computation. The observations of from two to five stations situated in or near the catchment are usually enough. (Knapp-USGS)
W70-07182

MATHEMATICAL MODELING OF SNOW COVER FORMATION AND COMPUTATION OF THE SUPPLY OF WATER TO THE SURFACE OF A MOUNTAIN BASIN,
For primary bibliographic entry see Field 02C.
W70-07210

AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
George M. Hornberger, Janet Ebert, and Irwin Remson.
Typescript, 1969. 22 p, 10 fig, 24 ref. NSF Grant 4525.

Descriptors: *Numerical analysis, *Linear programming, *Groundwater movement, *Flow, *Aquifers, *Streams, Boundaries (Surfaces), Floods.
Identifiers: *Boussinesq equation, Werner-Sundquist model.

An efficient numerical technique was used to obtain solutions of the Boussinesq equation for problems of groundwater recession and groundwater flow in response to changes in stream stage. Comparison of the numerical results with the analytical solution of Boussinesque attested to the accuracy of the former. The solution of the recession problem indicated that the form of the Werner-Sundquist model of groundwater-discharge recession was appropriate. The solution of the problem involving changing boundary conditions on an aquifer due to a flood wave provided data relative to groundwater outflow. Comparison with the results of Cooper and Rorabaugh evaluated the applicability of a linear model of unconfined flow. (Kriss-Cornell)
W70-07232

THERMAL REGIME OF CRIMEAN RIVERS AND INFLUENCE ON IT OF KARST WATER FEEDING,
Ukrainskii Nauchno-Issledovatelskii Gidro-Meteorologicheskii Institut, Kiev (USSR).
A. V. Plashchev.
Transl. of Trudy Vkrain. Gidrometeorol. Instituta No. 60, 1966. p 97-106. Soviet Hydrology: Selected Papers 1966, No. 2, p 182-189.

Descriptors: *Thermal properties, *Temperature, Geothermal studies, Heat transfer, Heat flow, Streams, Karst, Rivers, Water temperature, Air temperature, Hydrology, Seasonal.

The thermal characteristics of Crimean rivers are examined in relation to their feeding by karst waters on the basis of observational data. Information is obtained on water temperature variations along a river and with elevation, on the difference of water temperature in the main river and tributaries, and on the dates of its transitions through certain gradation. Rivers of the Crimean Mountains have positive water, tw, and air, ta, temperature differences in cold period of the year and negative differences in the warm period. The tw/ta ratio depends on the distance of the river reach from the source of karst water supply. The tw/ta ratios for different Crimean rivers are presented. The study proved that the thermal regime of Crimean rivers, particularly in the upper and partly in the middle reaches, is determined by karst water feeding. (Novotny-Vanderbilt)
W70-07323

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

CONJUNCTIVE USE SYSTEMS ANALYSIS,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-07328

A RAINFALL-RUNOFF SIMULATION MODEL FOR ESTIMATION OF FLOOD PEAKS FOR SMALL DRAINAGE BASINS--A PROGRESS REPORT,
Geological Survey, Fort Collins, Colo., and Geological Survey, Menlo Park, Calif.
David R. Dawdy, Robert W. Litchty, and James M. Bergmann.
U S Geological Survey Open-file Report, 1970. 102 p, 15 fig, 12 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Simulation analysis, *Mathematical models, Optimization, Parametric hydrology, Flood forecasting, Streamflow forecasting, Infiltration, Streamflow, Runoff, Runoff forecasting, Rain gages, Digital computers, Data collections, Computer programs, Model studies, Systems analysis.
Identifiers: Rainfall-runoff models.

A parametric rainfall-runoff simulation model is used with data of a point rainfall gage and daily potential evapotranspiration to predict flood volume and peak rates of runoff for small drainage areas. The model is based on bulk-parameter approximations to the physical laws governing infiltration, soil moisture accretion and depletion, and surface streamflow. Three case studies are presented in which an objective fitting method is used for determining optimal best-fit sets of parameter values for the data available for use in predicting flood peaks. Errors of prediction result from both errors of rainfall input and lack of model equivalence to the physical prototype. These two sources of error seem to be of the same order of magnitude for a model of the level of simplicity of that presented. Major gains in accuracy of simulation will require improvements in both data and model. The limit of accuracy of prediction of flood peaks by simulation with a bulk-parameter model using a single rain gage seems to be on the order of 25 percent. (Knapp-USGS)
W70-07365

SNOWMELT SIMULATION,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02C.
W70-07536

2B. Precipitation

MATHEMATICAL MODELS OF AREA RAINFALL,
State Rivers and Water Supply Commission, Melbourne (Australia).
G. N. Alexander.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 81-100, 1969. 20 p, 5 fig, 1 tab, 12 ref.

Descriptors: *Flood forecasting, *Mathematical models, *Statistical models, *Rainfall disposition, *Distribution patterns, Depth-area-duration analysis, Duration curves, Hydrographs, Hyetographs, Streamflow forecasting, Runoff forecasting, Probability.
Identifiers: Area rainfall models.

The use of mathematical models of area rainfall in flood forecasting is discussed. Both deterministic and probabilistic models may be used, depending on conditions and the climatic records available. Only by study of rainfall in three dimensions, that is in depth and over areas, will a unifying treatment of rainfall distribution suitable for use in flood estimation be obtained. It is necessary to eliminate some misconceptions and then postulate models that can be tested with the large volume of rainfall data available. The spatial models discussed should assist in estimating flood magnitudes from rainfall. (Knapp-USGS)
W70-07175

PROBABLE MAXIMUM AND TVA PRECIPITATION FOR TENNESSEE RIVER BASINS UP TO 3,000 SQUARE MILES IN AREA AND DURATIONS TO 72 HOURS,
Weather Bureau, Silver Spring, Md. Office of Hydrology.
Francis K. Schwarz, and Norbert F. Helfert.
U S Weather Bureau Hydrometeorological Report No 45, May 1969. 166 p, 91 fig, 26 tab, 33 ref. Tenn Valley Authority, Contract TV-23942A.

Descriptors: *Probable maximum precipitation, *Antecedent precipitation, *Tennessee Valley Authority Project, Hydrology, Meteorology, Estimating, Rainfall disposition, Flood forecasting, Runoff forecasting, Streamflow forecasting.
Identifiers: Tennessee Valley.

Generalized estimates are given of 1- to 72-hr precipitation extremes for basins in the TVA region ranging in size from a few square miles to about 3000 square miles. Antecedent rainfall criteria are provided also for use as indices to soil moisture conditions and existing streamflows at the beginning of the critical rainfalls. (Knapp-USGS)
W70-07195

FACTORS FORMING THE CHEMICAL COMPOSITION OF PRECIPITATION,
Politekhnicheskii Institut, Novocherkassk (USSR).
For primary bibliographic entry see Field 02K.
W70-07206

METEOROLOGICAL TABLES FOR DETERMINATION OF PRECIPITABLE WATER, TEMPERATURES, PRESSURES ALOFT FOR A SATURATED PSEUDOADIABATIC ATMOSPHERE - IN THE METRIC SYSTEM,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 07C.
W70-07228

FREEZING TEMPERATURES OF WATER DROPLETS IN EQUILIBRIUM WITH DIFFERENT GASES,
Pennsylvania State Univ., University Park, Pa. Dept. of Meteorology.
Jorge Pena, and Rosa G. de Pena.
Journal of Geophysical Research, Vol 75, No 15, p 2831-2835, May 20, 1970. 5 p, 3 fig, 2 tab, 10 ref. NSF Grant GA 3956.

Descriptors: *Freezing, *Water vapor, *Clouds, *Supercooling, *Clathrates, Hydrate processes, Hydrates, Carbon dioxide, Argon, Methane, Atmosphere, Cloud physics, Precipitation (Atmospheric), Water chemistry, Water properties, Thermodynamics.
Identifiers: Clathrate thermodynamics, Sulfur dioxide.

Many gases react with water at low temperature to form hydrates called clathrates. Among the atmospheric gases, carbon dioxide, argon, methane, and sulfur dioxide behave in this way. The influence of gases forming clathrates at the freezing temperature of water droplets was investigated to study the possible influence of the clathrates on the freezing of cloud droplets. Gases with very low solubility in water have no effect or a very small one. Gases having higher solubilities increase the supercooling, but the increase is greater than the lowering of the freezing point expected because of dissolved gas. The clathrate structure has an inhibiting effect on the freezing of supercooled water droplets. This inhibiting effect should not have a detectable influence on the freezing of cloud droplets because of the low concentration of these gases in the atmosphere. (Knapp-USGS)
W70-07335

INTERNATIONAL SYMPOSIUM ON ATMOSPHERIC TRACE CONSTITUENTS AND ATMOSPHERIC CIRCULATION.

Journal of Geophysical Research, Vol 75, No 15, p 2875, May 20, 1970. 1 p.

Descriptors: *Conferences, *Trace elements, *Atmosphere, *Air circulation, Tracers, Fallout, Atmospheric physics, Cloud physics, Air masses, Precipitation (Atmospheric), Tritium, Deuterium, Radioisotopes, Stable isotopes, Water chemistry.
Identifiers: Atmospheric trace elements.

A Symposium on Atmospheric Trace Constituents and Atmospheric Circulation was held in Heidelberg, Germany, September 8-13, 1969. The symposium was sponsored jointly by the World Meteorological Organization and IAMAP. The University of Heidelberg was host organization. More than 100 scientific papers were presented in symposium sessions on the following topics: Tracers and Transport Processes; Radioactive Aerosol Transport and Fallout; Radiocarbon and Tritium Distribution; Aerosol Formation and Removal Processes; Atmospheric Trace Gas Distribution; Aerosol Distribution and Composition; Upper Atmosphere Constituents; Atmospheric Geochemistry; Emanations and Daughters as Tracers; Air and Precipitation Chemistry; and Cosmogenic Radiosotopes as Tracers. (Knapp-USGS)
W70-07336

APPLICATION OF SHORT-LIVED COSMOGENIC RADIONUCLIDES AS TRACERS OF IN-CLOUD SCAVENGING PROCESSES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. W. Perkins, C. W. Thomas, and J. A. Young.
Journal of Geophysical Research, Vol 75, No 15, p 3076-3087, May 20, 1970. 12 p, 10 fig, 1 tab, 11 ref. AEC Contract AT (45-1)-1830.

Descriptors: *Radioisotopes, *Trace elements, *Tracers, *Atmosphere, *Precipitation (Atmospheric), Atmospheric physics, Rainfall, Cloud physics, Sampling, Instrumentation, Fallout.
Identifiers: Cosmogenic radionuclides.

Measurements of the cosmogenic radionuclides Cl-38 (37.3 min half-life), Cl-39 (55 min), and Na-24 (15 hours) in consecutive rain water samples during storms provide a basis for studying precipitation formation processes. These radionuclides, which result from cosmic-ray spallation of atmospheric argon, 'label' the natural aerosols, and can thus serve as tracers of in-cloud scavenging. Rain collected on a polyethylene sheet is continuously passed through ion exchange beds which retain the radionuclides. Subsequent direct counting of the beds by selective coincidence counting techniques allows their direct measurement. Analysis of rain samples collected over consecutive periods as short as 10 min has established several basic relationships from which the rates and possible mechanisms of various in-cloud precipitation formation and scavenging process are determined. (Knapp-USGS)
W70-07337

TRACE ELEMENT CONCENTRATIONS IN THE TROPOSPHERE AND LOWER STRATOSPHERE.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 02K.
W70-07338

EVOLUTION OF THE ISOTOPIC COMPOSITION OF ATMOSPHERIC WATERS IN THE MEDITERRANEAN SEA AREA,
Weizmann Inst. of Science, Rehovot (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 02K.
W70-07339

THE SEASONAL VARIATION IN THE CONCENTRATION OF STRONTIUM 90 IN RAIN AND ITS DEPENDENCE ON LATITUDE,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
For primary bibliographic entry see Field 05B.
W70-07340

DAILY VARIATIONS IN THE TRITIUM CONCENTRATION OF ATMOSPHERIC MOISTURE,
Gakushuin Univ., Tokyo (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 05B.
W70-07341

MECHANISMS OF TRANSPORT FROM THE ATMOSPHERE TO THE EARTH'S SURFACE,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
U. Moller, and G. Schumann.
Journal of Geophysical Research, Vol 75, No 15, p 3013-3019, May 20, 1970. 7 p, 5 fig, 18 ref.

Descriptors: *Mass transport, *Fallout, *Air-water interfaces, *Diffusivity, *Path of pollutants, Precipitation (Atmospheric), Trace elements, Laboratory tests, Winds, Water pollution sources, Sea water, Sampling, Tracers, Tracking techniques, Diffusion.
Identifiers: Wind tunnels.

Wind-tunnel experiments were made with wind speeds of 3 through 8 m/sec to study deposition of particles and gases on a water surface. The deposition velocity was measured for water vapor, carbon dioxide, atomic lead, purified-water residual nuclei, sodium chloride aerosols, and polystyrene latex spheres. Radioactive tracers were used for detection. The studies covered diffusion coefficients from 10 to the -7 power to 0.25 sq cm/sec, with all tests carried out under the same conditions. The results are best fitted by a relation in which velocity varies as the 2/3 power of the diffusion coefficient in the range 0.02 to 0.00002 thus favoring the concept of proportionality between the characteristic length in the turbulent boundary layer and the height above the surface. (Knapp-USGS)

W70-07342

METEOROLOGICAL RECORDS FOR LAKESIDE, 1968 AND 1969.
State Univ. Coll., Fredonia, N.Y.
RICHARD Carroll, and John A. Jones.
New York State University, Fredonia, Technical Data Report No 6, Lake Erie Environmental Studies, May 1970. 28 p, 3 fig, 2 ref, append.

Descriptors: *Climatic data, *Lake Erie, *New York, *Data collections, Climatology, Weather data, Temperature, Humidity, Winds, Solar radiation.
Identifiers: Lakeside laboratory (NY).

Reduced meteorological data are summarized for the latter half of 1968 and all of 1969 at the Lakeside Laboratory of Lake Erie Environmental Studies. The Lakeside Laboratory is located on the southeastern shore of Lake Erie. The laboratory is on a bluff 9 meters above lake level and about 100 meters from the shoreline behind a line of trees averaging about 15 meters high. The recording instruments include a thermograph, a hygrometer, an anemometer, a pyrheliograph, a rain and snow gage, and microbarograph. The period was selected for the availability of continuous records on the widest variety of instruments and the completeness of these records. Gaps in the records reflecting periods of instrument failure, are few. On the whole, the reporting period may be described as relatively typical for the region. Total precipitation for both years was quite close to normal. winter temperatures were atypically mild. Wind and pressure regimes are probably typical. (Knapp-USGS)
W70-07345

INTERNATIONAL GLOSSARY OF HYDROLOGY - SECOND DRAFT (JULY 1969).
For primary bibliographic entry see Field 10.
W70-07403

WESTERN SNOW CONFERENCE.

Proceedings available for sale by Western Snow Conference, Robert T. Davis, Secretary, Room 360, US Courthouse, Spokane, Wash, 99201. Proceedings 37th Annual Meeting of Western Snow Conference, April 15-17, 1969, Salt Lake City, Utah; printed by Colorado State University, Fort Collins, 1969. 110 p.

Descriptors: *Conferences, *Snow, *Snow surveys, *River forecasting, Water supply, Instrumentation, Social impact, Freezing, Melting, Telemetry, Evaporation, Sublimation, Water equivalent, Simulation analysis, Cloud seeding, Economics, Forecasting, Planning.
Identifiers: Western Snow Conference.

The 37th annual Western Snow Conference, Salt Lake City, 1969, includes papers on evaporation, sublimation, water content, runoff, soil water freezing, remote sensing, instrumentation, simulation of snowmelt, snow structure, cloud seeding, forecasting, and social and economic aspects of forecasting. Each paper includes an abstract, subject, and author index. The minutes and attendance list of the meeting are also included. (See also W70-07531 thru W70-07542 and W70-07676 thru W70-07678). (Knapp-USGS)
W70-07530

COMPUTER DETERMINATION OF CLOUD SEEDING AREA OF EFFECT,
North American Weather Consultants, Goleta, Calif.
For primary bibliographic entry see Field 03B.
W70-07538

AIRBORNE SEEDING TECHNIQUES APPLIED TO WINTER OROGRAPHIC CLOUDS,
EG and G, Inc., Boulder, Colo. Environmental Services Operation.
For primary bibliographic entry see Field 03B.

W70-07539

2C. Snow, Ice, and Frost

PLAN AND PROFILE CHARACTERISTICS OF BEACHES IN THE CANADIAN ARCTIC ARCHIPELAGO,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
S. B. McCann, and E. H. Owens.
Shore and Beach, Vol 38, No 2, p 26-30, April 1970. 5 p, 4 fig, 8 ref.

Descriptors: *Beaches, *Cold regions, Erosion, Sediment transport, Deposition (Sediments), Beach erosion, Waves (Water), Sea ice, Ocean waves, Tidal effects, Surf.
Identifiers: Canadian Arctic Archipelago.

A reconnaissance of beaches in the Southern Queen Elizabeth Islands in the Canadian Arctic Archipelago during 1967 led to the selection of two sites, at Cape Ricketts and Beechy Island, on southwest Devon Island, which were used for detailed field investigations of the physical and dynamic properties of the beach zone, using the same sedimentological and surveying techniques normally used in studies of lower latitude shorelines. Meteorological data is available from the weather station at Resolute, 105 km to the west of Cape Ricketts. The adjacent sea areas are flown regularly by ice patrols so that records of the distribution and movement of the sea ice cover are readily available. The many similarities of form between the beaches and southwest Devon and those of non-Arctic areas attests to the fact that the same littoral processes, in terms of wave and current action, operate in this region as elsewhere in the world. Normal methods of investigation and measurement are applicable in this area and provide information which may be compared with data from studies in other environments. The role of ice, largely as a negative factor in preventing wave generation at sea and wave action on the beach, does not cause any very significant changes in beach plan or profile. (Knapp-USGS)
W70-07152

SNOWFIELD MAPPING WITH K-BAND RADAR,
Kansas Univ., Lawrence. Remote Sensing Lab.
For primary bibliographic entry see Field 07B.
W70-07157

METHOD OF COMPUTING THE DYNAMICS AND YIELD OF SNOW WATER,
G. Ye. Glazyrin, and P. K. Lifanov.
Transl. from Trudy SANIGMI, No 39 (5), p 24-29, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 615-620, 1968. 1 fig, 10 ref.

Descriptors: *Water yield, *Snowmelt, *Snow cover, Rivers, Heat flow, Equations, Mountains, Snow management, Runoff, Snowpacks, Runoff forecasting.
Identifiers: *USSR.

Snow melting and the water yield from snow cover are the main factors determining the hydrologic regimes of the majority of mountain and lowland rivers. The water yield intensity is proportional to melting intensity. The regulating effect of snow layers can not be neglected if the daily runoff pattern from the snow cover must be know. If a more accurate account of the change in the water content of a snow layer is needed, then information on the internal structure of the snow cover at the beginning of the period for which the computations are made is needed. In this case the heat flux in the snow layer and its derivative in the respect to depth are also necessary. A system of equations is given for these calculations. (Carstea-USGS)
W70-07207

MATHEMATICAL MODELING OF SNOW COVER FORMATION AND COMPUTATION OF THE SUPPLY OF WATER TO THE SURFACE OF A MOUNTAIN BASIN,
L. N. Borovikova.
Transl. from Trudy SANIGMI, No 39 (5), p 37-43, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 620-625, 1968. 3 fig, 1 tab, 5 ref.

Descriptors: *Mathematical models, *Model studies, *Snow cover, *Snowmelt, *Water supply, Water yield, Basins, Rivers, Glaciers, Gaging stations, Snow surveys, Rain water.
Identifiers: *USSR, Akhangaran River, Alarcha River, Malaya Almaatinka River.

A mathematical model of snowmelt-runoff relations takes into consideration the variation of air temperature with time and refines the melting coefficients. The scheme for computing the supply of water to a basin surface also allows for meltwater derived from glaciers. Computations of water supply from snow cover were made for the Akhangaran River basin, and the Alaarcha and Malaya Almaatinka Rivers, USSR. Good agreement was found between the computed distribution of the amount of water in snow with elevation and that measured at snow gaging stations during snow surveys. The total inflow to the basin is the sum of 3 components: inflow of melt, rain water, and water from the melting of glaciers. Examples of computations are given. (Carstea-USGS)
W70-07210

NOTE ON SOME VERTICAL PROFILES BELOW ICE FLOES IN THE GULF OF ST. LAWRENCE AND NEAR THE NORTH POLE,
McGill University, Montreal (Quebec). Marine Sciences Centre.
Ola M. Johannessen.
Journal of Geophysical Research, Vol 75, No 15, p 2857-2861, May 20, 1970. 5 p, 3 fig, 1 tab, 9 ref. National Research Council of Canada, Grant T-2645.

Descriptors: *Currents (Water), Sea ice, *Roughness (Hydraulic), *Flow profiles, Flow measurement, Current meters, Profiles, Hydraulics, Aquatic drift, Drifting (Aquatic).
Identifiers: Sea ice floes.

The vertical current-velocity profile method was used to estimate the roughness parameter for the lower surface of different ice floes. The roughness parameter varied from 0.2 cm for smooth arctic ice to 10 cm for rough ice in the Gulf of St. Lawrence. The thickness of the boundary layer under smooth arctic ice is estimated to 1 meter and for the ice in the Gulf of St. Lawrence to 0.6 meter or less. (Knapp-USGS)
W70-07353

A POSSIBLE RELATION BETWEEN GRAIN SIZE, DENSITY, AND LIGHT ATTENUATION IN NATURAL SNOW COVER,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
James D. Bergen.
J Glaciology Vol 9, No 55, p 154-156, 1970.

Descriptors: *Snow, *Light penetration, *Optical properties, Snow cover, Snowpack, Light, Opacity, Radiation, Physics, Solar radiation.
Identifiers: *Snow cover opacity.

The extinction coefficient for the transmission of light through snow cover is related to the grain size and density of the snow cover. The connection is made by means of an empirical relation between the latter parameters and the air permeability and by the Carmen-Kozney relation between the air permeability and specific surface of a porous medium. The results are compared with a set of measurements found in the literature with fair agreement between the predicted and measured values of the extinction coefficient. (Bergen-Forest Service)
W70-07514

THE CLASSIFICATION OF SNOW METAMORPHISM,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
R. A. Sommerfeld, and E. LaChapelle.
Journal of Glaciology, Vol 9, No 55, p 3-17, 1970.

Descriptors: *Snow cover, *Snowpacks, *Avalanches, Firm, Crystals, Snowmelt, Slopes, Colorado.
Identifiers: Depth hoar, Metamorphism (Snow).

A new classification of snow on the ground is based on the major physical processes involved in the metamorphism of a snow cover. The major divisions are based on (I) the mechanical damage to snow crystals during precipitation, (II) the transport of water vapor at constant temperature because of surface energy differences, (III) the transport of water vapor along a thermal gradient, and (IV) firnification because of melting and refreezing, and pressure consolidation.
W70-07516

SNOWPACK DENSITY, WATER CONTENT AND RUNOFF ON A SMALL ARIZONA WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
Peter F. Ffolliott, and David B. Thorud.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 12-18, 1969. 7 p, 7 fig, 3 tab, 16 ref.

Descriptors: *Snowpacks, *Melting, *Runoff forecasting, *Snowmelt, Water yield, Water supply, Heat balance, Snow management, Water management (Applied).
Identifiers: Snowpack ripening.

Snow density is one useful index of the stage of 'ripening' in a snowpack. Fresh snow often has a density of 0.10 gm per cc or less. As the snowpack undergoes metamorphosis and ripening a density of 0.35 to 0.50 gm per cc is attained. In Arizona the snowpack is usually 'ripe' in this range. Additional energy input to the snowpack will cause runoff. In field study of Arizona snowpacks, ripening was rapid. Six days after peak snowpack accumulation the number of sample points with a density of 0.37 gm per cc or greater increased from 1% to about 50%. However, at this time and for a considerable portion of the runoff period, 20% of the points had snow with a density of 0.30 gm per cc or less. This snow was probably not yielding melt water. The snowpack water content did not appear to be normally distributed. The coefficient of variation increased with time. Relationships between snowpack density, water content, timber stocking, elevation, and potential insolation were weak. (See also W70-07532). (Knapp-USGS)
W70-07531

SOIL-WATER FREEZING, SNOW ACCUMULATION AND ABLATION IN MARMOT CREEK EXPERIMENTAL WATERSHED, ALBERTA, CANADA,
Department of Fisheries and Forestry, Calgary (Alberta).
R. L. Harlan.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 29-33, 1969. 5 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Snowmelt, *Recharge, *Infiltration, *Runoff, *Surface-groundwater relationships, Water yield, Water supply, Demonstration watersheds, Ablation, Snow surveys, Rainfall-runoff relationships, Base flow.
Identifiers: Experimental watersheds.

A research program was initiated in the early 1960's to explore the interrelationships between vegetation, soil, climate, and water on the eastern slope of the Canadian Rocky Mountains. The relations between soil-water and soil-temperature conditions and snow accumulation and ablation, vegetation, and slope orientation were determined. Thawing of soil occurred both from above and and from below. In the 1966 and 1967 snowmelt periods, soil thawing occurred before snowpack ablation; whereas during 1965, the soil remained partly frozen until after complete disappearance of the snowpack. The snowpack was depleted most rapidly beneath immature lodgepole pine cover and was most persistent beneath uncut spruce-fir. Only a small percentage of the water in the snowpack entered soil-water storage during snowmelt. Hydrograph analysis showed that although moderate increases in streamflow do occur during snowmelt, these discharges are indicative of increased baseflow, not surface runoff. Since snowmelt appeared neither as soil-water recharge now as overland flow, it is implicit that snowmelt contributed directly to groundwater except when melt precedes thawing of the soil profiles or is lost to evaporation. (See also W70-07534). (Knapp-USGS)
W70-07533

SATELLITE PHOTOGRAPHY FOR SNOW SURVEILLANCE IN WESTERN MOUNTAINS,
Allied Research Associates, Inc., Concord, Mass.
For primary bibliographic entry see Field 07B.
W70-07534

HYDROLOGY OF SNOW PROFILES OBTAINED WITH THE PROFILING SNOW GAGE,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
James L. Smith, and Howard G. Halverson.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 41-48, 1969. 8 p, 8 fig, 1 tab, 2 ref.

Descriptors: *Snowpacks, *Nuclear moisture meters, *Water yield, Profiles, Snowmelt, Runoff forecasting, Water supply, Melt water, Instrumentation, Snow management, Snow surveys.
Identifiers: Snow moisture meters, Meltwater movement.

A profiling radioactive snow gage was developed at the Central Sierra Snow Laboratory. With the profiling snow gage one may profile a snowpack at a speed of one foot per minute. Density in percent and depth in feet to hundredths of feet are printed out for approximately each one-half inch interval throughout the pack. Accuracy of the system can be within one-half of one percent of absolute accuracy. The data are accurate to within 1.5 percent of true density. Following the development of the snow gage, daily and more frequent profiles have been collected from snowpacks during the winters of 1966-67, 1967-68, and 1968-69. From study of these profiles new data on water-holding capacities for snowpacks in various stages of metamorphism have been examined in the light of previous concepts. Liquid water is held in the pack in three forms: Hygroscopic water - or water absorbed onto the surface of the crystal and probably absorbed into the crystal; capillary water - or water held by surface tension in the capillary spaces; and gravitational water - that water which is in transit through the pack. (See also W70-07536). (Knapp-USGS)
W70-07535

SNOWMELT SIMULATION,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
J. Paul Riley, Duane G. Chadwick, and Keith O. Eggleston.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 49-56, 1969. 8 p, 8 fig, 10 ref.

Descriptors: *Snowmelt, *Mathematical models, *Simulation analysis, Model studies, Energy budget, Heat budget, Ablation, Evaporation, Solar radiation, Snow management, Temperature, Runoff forecasting, Streamflow forecasting.
Identifiers: Snowmelt simulation.

A preliminary mathematical model of the snowmelt process has been developed in which processes such as pack settlement rates and energy flow in the pack by means of both conduction and liquid movement are considered. Factors such as temperature, surface albedo, and degree and direction of slope are also included. A temperature criterion is applied to predict the form of precipitation input (snow or rain) to the model. Equations of the various processes are synthesized into a dynamic model of the total system by means of an electronic analog computer. Field data from snow laboratories operated by the Corps of Engineers and highly instrumented watersheds of the ARS are being used to test and verify the model. Initial results have indicated close agreement between observed and computed results. Sensitivity studies have been conducted, and work is continuing to further test and improved the model. (See also W70-07537). (Knapp-USGS)
W70-07536

COMPARISON OF GRAVIMETRIC MEASUREMENTS AND MASS TRANSFER COMPUTATIONS OF SNOW EVAPORATION BENEATH SELECTED VEGETATION CANOPIES,
Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.
Robert D. Doty, and Robert S. Johnston.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 57-62, 1969. 6 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Evaporation, *Snowpacks, *Vegetation effects, Instrumentation, Water management (Applied), Forecasting, Runoff forecasting, Water yield, Water supply, Snow management.
Identifiers: Snowpack evaporation.

Snow evaporation was studied at two sites at 7,000 feet elevation about 30 miles east of Logan, Utah. Both sites were located in the fairly level bottom of a U-shaped valley, with scattered aspen and conifer stands, with large openings. One site was an aspen stand with an average height of 60 ft and basal area of 91 sq ft per acre. The second site, one-quarter mile away, had a dense mixed conifer stand with an average hieght of 67 ft and basal area of 100 sq ft per acre. Evaporation on only one site was measured on any given day. Evaporation loss was measured gravimetrically from clear plastic evaporimeters. Meteorological instruments were a sheltered hygrothermograph and totalizing anemometer. Both were positioned one meter above the snow surface, and a pyrheliometer was located midway along and to the lee of each line of evaporimeters. Snow surface temperatures were measured with a Stoll-Hardy radiometer. All meteorological data were recorded at intervals of one hour. Evaporation was greatest in the open, intermediate in the aspen stand, and least under the conifer stand. The maximum evaporation in the open (0.076 gm/sq cm) and in the aspen (0.068 gm/sq cm) occurred on the same day in March when the highest average temperatures and wind speeds were recorded for both areas. The minimum evaporation was recorded in the aspen stand in January when the average temperature was 3.2 deg C, average wind was 6.2 cm/sec, and the average relative humidity was 82.4%. (See also W70-07538). (Knapp-USGS)
W70-07537

A 2-YEAR EVALUATION OF THE SNOWMELT LYSIMETER,
Forest Service, Moscow, Utah. Forestry Sciences Lab.
For primary bibliographic entry see Field 07B.
W70-07541

A SNOWPACK EVAPO-SUBLIMATION FORMULA,
Soil Conservation Service, Casper, Wyo. Snow Survey.
George W. Peak.

Proceeding 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 1-11, 1969. 11 p, 17 plate.

Descriptors: *Evaporation, *Snowpacks, Water management (Applied), Forecasting, Runoff forecasting, Streamflow forecasting, Water yield, Water supply, Snow management.
Identifiers: Snowpack evaporation.

Snowmelt-runoff equations are presented for watersheds with alpine areas, or open range at deep snowpack elevations. Factors are given to adjust for the variable and substantial evapo-sublimation losses. Radiation must be measured on a local basis. Forecasts can have good accuracy if alpine wind, temperature, insolation and humidity data are available. (See also W70-07530). (Knapp-USGS)
W70-07542

2D. Evaporation and Transpiration

COMPARISON OF GRAVIMETRIC MEASUREMENTS AND MASS TRANSFER COMPUTATIONS OF SNOW EVAPORATION BENEATH SELECTED VEGETATION CANOPIES,
Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02C.
W70-07537

A SNOWPACK EVAPO-SUBLIMATION FORMULA,
Soil Conservation Service, Casper, Wyo. Snow Survey.
For primary bibliographic entry see Field 02C.
W70-07542

2E. Streamflow and Runoff

RECONNAISSANCE OF THE PIGEON RIVER, A COLD-WATER RIVER IN THE NORTHCENTRAL PART OF MICHIGAN'S SOUTHERN PENINSULA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07166

HYDROGEOLOGY AND WATER QUALITY STUDIES IN THE CACHE LA POUDRE BASIN, LARIMER AND WELD COUNTIES, COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 05B.
W70-07167

THE MOVEMENT OF FLOOD-WAVES IN NATURAL CHANNELS AND SOME PROBLEMS OF RIVER DISCHARGE AND STAGE FORECASTING,
Hydrometeorological Service of the USSR (Moscow).
E. G. Popov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 14-24, 1969. 11 p, 3 fig, 17 ref.

Descriptors: *Flood forecasting, *Unsteady flow, *Equations, Mathematical studies, Estimating, Statistical methods, Computer programs, Digital computers, Reviews, Hydrograph analysis, Network design.
Identifiers: USSR, Saint-Venant equations.

The methods and techniques of short-range river discharge and stage forecasting based on the laws of water flow in channels and in particular on the laws of movement and transformation of flood-waves within limited river reaches are reviewed. The period of time which can be covered by such forecasts depends mainly on the wave speed and the length of river reaches. The complexity of unsteady flow in natural channels and the lack of data are the main causes for the approximate nature of the forecasting techniques used at present, the simplest of which have been known since the last century. Electronic computers make it possible nowadays to use more reliable hydrodynamic methods, but their application is limited in many cases by lack of data. For this reason approximate methods, based on current information, still retain their practical value. Unsteady flow in natural channels may be described by two differential equations in partial derivatives known as the Saint-Venant equations. The computation of unsteady flow is possible only by means of numerical integration of these equations. The most widespread method of numerical integration is the network method based on the replacement of partial derivatives by the finite difference ratios with consecutive solution of the system of algebraic equations. (Knapp-USGS)
W70-07172

THE ACQUISITION OF DATA FOR FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
D. N. Body.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 69-72, 1969. 4 p, 5 ref.

Descriptors: *Flood forecasting, *Network design, *Hydrologic data, *Data collections, Instrumentation, Data processing, Stream gages, Rain gages, Telemetry, Surveys, Data transmission, Remote sensing.
Identifiers: Data requirements.

In any operational flood-forecasting system the observation and transmission of the data upon which the forecasts are to be based are vital. With the development of improved techniques for the formulation of forecasts it is most likely that the requirement for data will be increased, both in terms of the number of elements to be observed and the frequency of observation. In most instances these requirements will be such as to preclude the use of voluntary part-time observers. These facts demonstrate the need to develop data-acquisition systems concurrently with improved techniques of flood forecasting. Such systems must be unaffected by severe weather conditions and should produce the data in a form suitable for direct treatment by computers. Because of the limited manpower which can usually be allocated to operational forecasting, data-acquisition systems should be designed to operate automatically whether they are based on observers or telemetering equipment. In this way the forecaster can concentrate on his major task, the formulation of the forecast. (Knapp-USGS)
W70-07173

SOME POTENTIAL APPLICATIONS OF METEOROLOGICAL SATELLITES IN FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 07B.
W70-07174

RIVER FORECASTING TECHNIQUES IN KOREA,
Ministry of Construction, Seoul (South Korea).
Yun Sik Lee.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 103-109, 1969. 7 p, 3 fig, 2 tab.

Descriptors: *Flood forecasting, *Statistical methods, *Warning systems, Flood control, Routing, Rainfall-runoff relationships, Stage-discharge relations, Flood protection, River forecasting.
Identifiers: *Republic of Korea.

Flood forecasting methods used in the Republic of Korea include graphically correlating the stages of the country's rivers with each other, and using stage-travel time relations to predict arrival of floods downstream from observation points. Because the country cannot afford flood control reservoirs or channel improvements, a disaster prevention law was enacted to integrate national flood damage prevention and relief work. (Knapp-USGS)
W70-07176

DEVELOPMENT OF A FLOOD-FORECASTING SYSTEM FOR THE LATROBE RIVER AT YALLOURN,
Bureau of Meteorology, Melbourne (Australia).
G. Heatherwick.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 110-132, 1969. 23 p, 16 fig, 7 tab, 2 ref.

Descriptors: *Flood forecasting, *Unit hydrographs, *Data processing, Recession curves, Hydrograph analysis, Streamflow forecasting, Stream gages, Rain gages, Rainfall-runoff relationships, Depth-area-duration analysis.
Identifiers: Australia, Latrobe River.

The procedures currently used for the development of flood-forecasting systems in Australian conditions are briefly outlined. Operational systems have been based entirely on the prediction of streamflow direct from rainfall. Because of the need to reduce the volume of data to a minimum the emphasis has been on simplicity. This led to the establishment of unit hydrograph analysis and digital data reduction systems which deal adequately with average situations but lack the flexibility to handle unusual ones with the same accuracy. (Knapp-USGS)
W70-07177

FLOOD HYDROGRAPH CALCULATION WITH RUN-OFF TRANSFORMATION IN BASIN AND CHANNELS TAKEN INTO ACCOUNT,
D. A. Burakov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 139-146, 1969. 8 p, 2 fig, 4 tab, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Overland flow, *Streamflow forecasting, *Snowmelt, Marshes, Hydrograph analysis, Mathematical models, Water storage, Permeability, Infiltration.
Identifiers: USSR, Ob River, Irtysh River.

A method is given for solving problems of flood hydrograph calculation approximately at the confluence of the two largest rivers of the Soviet Union, the Ob and the Irtysh. The region is extremely flat, with a poor drainage network, and is almost completely swampy. The main phase of the water regime of the rivers is flood resulting from snowmelt and rainfall. Runoff is considerable, especially when heavy rains occur soon after snowmelt. In such years the rainfall runoff exceeds that of the snowmelt. Rainfall-flood hydrographs should be calculated with the specific physio-geographical conditions taken into account. In the river basins of the region under study, where the ground is mostly swampy, the forest soils are characterized by great permeability and groundwater is close to the surface. In deriving the runoff equations it is supposed that the nature of water absorption is similar to water retention on the surface of an impermeable basin with non-uniform distribution of depression capacity. The scheme outlined can be used for calculation and forecasts of rainfall runoff from rain-

fall data in regions with flat relief where overland runoff transformation is important. (Knapp-USGS)
W70-07178

FLOOD-WAVE FORMATION,
University Coll., Galway (Ireland); and State Rivers and Water Supply Commission, Melbourne (Australia).
For primary bibliographic entry see Field 02A.
W70-07179

THE FORMATION AND FORECASTING OF RAINFALL FLOODS,
I. N. Gartsman, and V. M. Lylo.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 156-161, 1969. 6 p.

Descriptors: *Rainfall-runoff relationships, *Routing, *Flood forecasting, Streamflow forecasting, Infiltration, Antecedent precipitation, Precipitation intensity, Unit hydrographs, Recession curves.
Identifiers: USSR.

A characteristic of the rivers of far-eastern regions of the U.S.S.R. is that floods occur repeatedly. The probability of heavy flooding is the same throughout that part of the year which is free from basal ice of rivers, even after a long period of drought. Every year in some region or other the floods on rivers attain catastrophic proportions, and in some seasons they take place in widely separated places. The flood runoff is formed in a number of stages: the precipitation of rain into catchment areas and its partial expenditure in loss; the formation of runoff when delivery exceeds the discharge; removal; flow into the river system; and the evacuation of floodwaters through the channel systems. In considering the processes which lead to the formation of floods, it is necessary to distinguish two types of runoff formation which have different causes. The first type, surface runoff formation, takes place when the intensity of rainfall exceeds the absorptivity of the soil surface. The second type of runoff formation occurs when the stored soil moisture exceeds the minimal moisture content or critical water-holding capacity. In far-eastern conditions it forms mainly in soil depths of up to one metre, and more rarely up to two metres. Both types of runoff formation cease as soon as rain ceases. Equations are presented for calculating both types of runoff formation using rain and stream gaging data, routed by the isochrone method. (Knapp-USGS)
W70-07180

DIGITAL SIMULATION METHODS FOR HYDROLOGICAL FORECASTING,
Stanford Univ., Calif.
N. H. Crawford.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 162-171, 1969. 10 p, 10 fig, 2 ref.

Descriptors: *Simulation analysis, *Mathematical models, *Streamflow forecasting, *Synthetic hydrology, *Computer programs, Model studies, Hydrograph analysis, Routing, Optimization.
Identifiers: *Stanford Watershed Model.

Streamflow simulation attempts to develop algorithms of hydrological processes for quantitative calculations. The method is based on the premise that hydrological reactions are deterministic; if two similar storms result in different hydrographs it is assumed that physically consistent processes at work in each of the storms were responsible. Hence if these physical processes could be adequately documented and modelled, the model should reproduce the reaction from both storms. Stanford Watershed Model IV, the most recent documented program developed by the Stanford Project in Hydrologic Simulation, is used for illustration. Flow charts for this program are shown. When streamflow simulation is operated for forecasting, problems are encountered due to partial data, data errors and conflicting evidence from the analysis of these data. Straightforward information display, and programming that allows an interaction between man and machine during forecast operations, are valuable. This insures that anomalous data or results are detected quickly. Programming that explores automatic error-resolution and man/machine interaction in forecast operations is currently under way at Stanford University. (Knapp-USGS)
W70-07181

MATHEMATICAL MODELLING OF THE RUN-OFF PROCESS OF RIVERS WITH COMPOUND ALIMENTATION,
For primary bibliographic entry see Field 02A.
W70-07182

THE APPLICATION OF CONCEPTUAL CATCHMENT MODELS TO RIVER FORECASTING,
Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 04A.
W70-07183

SHORT-TERM FLOOD FORECASTING WITH THE RETENTION MODEL,
New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 04A.
W70-07184

FLOOD FORECASTING AND CONTROL OF THE LEVEL OF LAKE BURLEY GRIFFIN,
Commonwealth Dept. of Works, Canberra (Australia).
For primary bibliographic entry see Field 04A.
W70-07185

SEASONAL LOW-FLOW FORECASTING,
Geological Survey, Washington, D.C.
H. C. Riggs, and R. L. Hanson.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, 286-299, 1969. 14 p, 17 fig, 8 ref.

Descriptors: *Low flow, *Base flow, *Streamflow forecasting, Recession curves, Meteorology, Routing, Mathematical models, Hydrograph analysis.
Identifiers: Low-flow forecasting.

Methods of forecasting low flow of streams with and without gaging stations are reviewed. To be of value, most forecasts of seasonal low flows should be made a month or more in advance. Thus usable forecasts may be made only on streams having a substantial base-flow component. The base-flow recession curve, used for several forecasting examples in this paper, is a rather imprecise tool. Groundwater concepts and aquifer characteristics may be used to forecast assured flow; in its present state of development the method requires considerable information in the basin and produces results comparable to those obtained from base-flow recession curves. Forecasting relations may be adequately defined graphically; there is little justification for an involved mathematical treatment. Selection of a forecasting procedure for a specific stream should be preceded by a brief study of the hydrology of the basin. Then the data available and the purpose of the forecast should indicate a suitable approach. (Knapp-USGS)
W70-07186

THE METHOD OF INFLUENCE-FUNCTION DETERMINATION FOR LINEAR RUN-OFF MODELS,
L. S. Kutchment.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 312-319, 1969. 8 p, 3 fig, 2 tab, 12 ref.

Descriptors: *Hydrograph analysis, *Rainfall-runoff relationships, *Mathematical models, *Streamflow forecasting, Linear programming, Equations, Mathematical studies, Unit hydrographs.
Identifiers: USSR.

In the calculation of runoff hydrographs, very often the hydrological objects (watershed, river sections) are looked upon as linear dynamic systems with lumped parameters. In such cases, the relation between input characteristics q (t) (hyetograph, inlet hydrograph, etc.) and the hydrograph at outlet Q (t) is expressed by the Duhamel integral, in which P (t) is the influence function on Q (t) of inlet characteristics. It is very easy to determine p (t) when the water delivery q (t) takes place for a short time (when q (t) is a delta function), or when it remains constant for a long time. In the first case, the hydrograph at the outlet is the influence-function multiplied by the volume of water delivery, and in the second case, it is the integral of the influence-function multiplied by the constant value of q (t). However, it is not always possible to find such limiting cases in field observations, and it is necessary to determine the influence-function for any type of function q (t) and Q (t). When using field measurements, which always contain errors, the initial functions cannot be given with absolute accuracy. In order to avoid such errors, one has to look for an optimal influence-function which would on the average satisfy the available information. An optimal influence-function was determined using observation data on the rivers Tvertsa and Svir in the downstream pool of Ivankov hydro-electric station and the observations for rainfall and runoff in the Kolima River basin. The methods discussed gave satisfactory results. (Knapp-USGS)
W70-07187

FLOOD-FORECASTING FROM DISCHARGE DATA IN DRAINAGE NETWORKS AND FROM PRECIPITATION,
V. I. Sapozhnikov.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 307-311, 1969. 5 p, 1 tab, 12 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Streamflow forecasting, *Runoff forecasting, Hydrograph analysis, Equations, Unit hydrographs.
Identifiers: USSR.

Rainfall-runoff relationships and routing methods used to forecast streamflow and floods in the USSR are reviewed and briefly described. The techniques include travel time curves, unit hydrographs, lag methods, and flood wave attenuation calculations. The equations used for each calculation are presented and explained. (Knapp-USGS)
W70-07188

ELEMENTS OF PREDICTION OF RUN-OFF FROM SMALL CATCHMENT BASINS,
J. Lambor.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 263-285, 1969. 23 p, 12 fig, 2 tab, 8 ref.

Descriptors: *Flood forecasting, *Streamflow forecasting, *Mathematical models, *Routing, *Meteorology, Synoptic analysis, Statistical methods, Simulation analysis, Model studies, Runoff forecasting, Water management (Applied), Hydrograph analysis, Unit hydrographs.
Identifiers: Small catchments.

lethods of forecasting runoff from small atchments are reviewed and briefly described. he principal difference between warnings and recasts is that warnings are long-range but only ualitative predictions, while forecasts are short-ange but quantitative. Hydrological forecasts are rmulated from hydrological elements, and eteorological forecasts are derived from eteorological elements. Both types can be based n direct interpretation of events which have al-eady happened and of their development in the nmediate future; they are commonly called short-ange forecasts. To this category belong the predic-on of water stages in the lower stream reaches ased on stage observations in the upper reaches, r runoff prediction from recorded precipitation ata, or short-range meteorological forecasts based n the barometric situation. Medium-range recasts are based on physical interpretation of he genesis of a hydrometeorological event and its xpected development, for example the develop-ent of the barometric situation, the character of ir masses, or the condensation processes of water apour. Long-range statistical forecasts, hydrologi-al as well as meteorological, are based on statisti-al treatment of the observed phenomena. (Knapp-SGS)
W70-07189

HE REPRESENTATIVE BASIN CONCEPT IN USTRALIA.
ustralian Water Resources Council, Canberra.
or primary bibliographic entry see Field 07A.
V70-07191

EW ENRICHMENT AND MULTIPLE SAM-LING PROCEDURES TO INVESTIGATE ADIOACTIVE TRACER MIXING IN A SMALL IVER,
gricultural Research Council of Central Africa, alisbury (Rhodesia).
or primary bibliographic entry see Field 07B.
V70-07196

RINCIPLES FOR THE DISTRIBUTION OF IN-ORMATION HYDROLOGIC POSTS,
or primary bibliographic entry see Field 07A.
V70-07199

METHOD FOR COMPUTING THE RUNOFF OMPONENT OF LEVEL FLUCTUATIONS AT IVER MOUTHS,
. V. Ivanov.
rans. from Trudy AANII, Vol 283, p 12-29, 1968. oviet Hydrology: Selected Papers, Issue No 6, p 00-615, 1968. 6 fig, 44 ref.

escriptors: *Water level fluctuations, *Runoff recasting, *Runoff coefficient, *Stage-discharge elations, Rivers, Winds, Channel morphology, ydrometry, Gaging stations, Coasts.
dentifiers: *USSR.

method is proposed for computing the runoff omponent of water level fluctuations in the mouth eaches of rivers. Some of the problems that may e treated are: (1) computation of wind-induced evel changes in the mouth reaches of rivers; (2) omparison between wind-induced and tidal level luctuations in the mouth reaches of rivers and in he mouth coastal waters; (3) determination of econdary effects of river runoff on their transfor-ation when the fluctuations move upstream; (4) nalysis of water regime and channel deformations n a zone of variable backwater; (5) application of he characteristic levels computed for reference aging stations on the river and in the sea to water-aging stations in the mouth region. (Carstea-SGS)
V70-07203

RINCIPLES FOR DISTRIBUTION AND ROSPECTS FOR DEVELOPMENT OF A YDROLOGIC NETWORK,
or primary bibliographic entry see Field 07A.
W70-07205

TECHNIQUES FOR EVALUATING LONG-TERM RESERVOIR YIELDS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 06A.
W70-07234

RECENT ADVANCES IN STORAGE AND FLOODING THEORY,
Office of Naval Research, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-07236

THE FULLY-MIXED STREAM TEMPERATURE REGIME,
Tennessee Valley Authority, Norris.
Walter O. Wunderlich.
Presented at ASCE Specialty Conference, Utah State University, Utah, August 20-23, 1969. Typescript, July 1969. 35 p.

Descriptors: *Temperature, *Thermal stratification, Turbulence, Heat flow, Energy budget, Rivers, Streams, Reynolds number, Boundary layers, Air-water interfaces, Heat transfer, Velocity, Channel flow, Diffusion, Radiation, Evaporation.
Identifiers: Thermal stratification stability criteria.

The thermo-hydrodynamic criteria are derived which can be used to determine whether the vertical heat distribution in a stream can be considered as homogeneous (fully mixed) or whether the streams will straifty or maintain an existing stratification. The internal turbulence in many streams is sufficient to assure instantaneous heat distribution from the surface downward. Layers of warm water on top of cold water may, however, appear and persist as soon as the turbulence decreases or is nonexistent as, for example, in stagnant bodies of water. Field data from two rivers, one in the process of warming, the other in the process of cooling, are used to demonstrate practical applications of the criteria. The criterion is based on comparison of meteorological Nusselt number with a dynamic transfer number which describes turbulent heat exchange in the body of flowing water. (Novotny-Vanderbilt)
W70-07324

EVALUATION OF NATURAL RIVERS,
Antioch Coll., Yellow Springs, Ohio.
For primary bibliographic entry see Field 06B.
W70-07327

FORMATION OF HYDRAULIC JUMPS IN A ROTATING SYSTEM,
Naval Postgraduate School, Monterey, Calif., and Utah Univ., Salt Lake City.
For primary bibliographic entry see Field 08B.
W70-07354

A RAINFALL-RUNOFF SIMULATION MODEL FOR ESTIMATION OF FLOOD PEAKS FOR SMALL DRAINAGE BASINS--A PROGRESS REPORT,
Geological Survey, Fort Collins, Colo., and Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02A.
W70-07365

WATER RESOURCES OF SOUTHERN MARYLAND,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07367

CHANGES IN NATURAL CHANNELS DOWNSTREAM FROM MAN-MADE RESERVOIRS,
Mississippi State Univ., State College. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-07519

SNOWPACK DENSITY, WATER CONTENT AND RUNOFF ON A SMALL ARIZONA WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
For primary bibliographic entry see Field 02C.
W70-07531

SOIL-WATER FREEZING, SNOW ACCUMULATION AND ABLATION IN MARMOT CREEK EXPERIMENTAL WATERSHED, ALBERTA, CANADA,
Department of Fisheries and Forestry, Calgary (Alberta).
For primary bibliographic entry see Field 02C.
W70-07533

2F. Groundwater

GROUND-WATER RESOURCES OF BASTROP COUNTY, TEXAS,
Geological Survey, Austin, Tex.
C. R. Follett.
Texas Water Development Board Report 109, March 1970. 138 p, 26 fig, 13 tab, 32 ref.

Descriptors: *Hydrologic data, *Groundwater, *Aquifers, *Texas, Water yield, Water wells, Water levels, Water quality, Water utilization, Data collections, Water supply, Sandstones.
Identifiers: Bastrop County (Tex).

The principal formations in Bastrop County, Texas that yield or are capable of yielding moderate or large quantities of water to wells are, in order of decreasing yields, the Wilcox Group, Carrizo Sand, Queen City Sand, and Sparta Sand. The Carrizo Sand and the underlying Wilcox Group are connected hydrologically and function as a single aquifer. The use of groundwater is gradually increasing, but the total of 3.7 mgd or 4,100 acre-feet per year used in 1966 is small compared to the quantity available. About 100 million acre-ft of fresh to slightly saline water is in transient storage in the principal aquifers, but only a fraction of this water is economically recoverable by known methods at present costs. The yields of wells in Bastrop County range from a few gallons a minute to about 1,800 gpm. Yields of at least 2,000 gpm are possible from properly constructed and screened wells in the Carrizo-Wilcox aquifer. The dissolved-solids content of selected water samples ranged from 67 to 4,020 mg/liter; 49% of the samples contained less than 500 mg/liter. Excessive iron is one of the county's chief water-quality problems as 74% of the samples contained more than 0.3 mg/liter iron. Most of the water sampled was moderately hard to very hard; about 80% of the samples exceeded 60 mg/liter hardness. (Knapp-USGS)
W70-07165

DETERMINATION OF GROUNDWATER AGES BY THE TRITIUM -- 3 He METHOD,
Institute of Precambrian Geology and Geochronology, Leningrad (USSR); and All-Union Petroleum Geology Exploration Inst.
For primary bibliographic entry see Field 07B.
W70-07168

DIRECTIONAL HYDRAULIC BEHAVIOR OF A FRACTURED-SHALE AQUIFER IN NEW JERSEY.,
Geological Survey, Trenton, N.J.
John Vecchioli.

French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 318-326, 1967. 9 p, 6 fig, 4 ref.

Descriptors: *Hydraulic properties, *Aquifers, *Shales, *Fractures (Geology), *New Jersey, Groundwater, Groundwater movement, Transmissivity, Fissures (Geology), Water sources, Geology, Water circulation, Water levels, Permeability, Faults (Geology), Water wells, Drawdown, Discharge (Water).
Identifiers: *Brunswick shale aquifer (N J).

The Brunswick shale of the Triassic age, which is the principal source of groundwater in the central and northeastern part of New Jersey, exhibits directional hydraulic behavior. Water levels in wells aligned along the strike of the formation show greater magnitude of interference than those aligned perpendicular to strike. Drawdown data evaluated by standard-time-drawdown methods indicate that computed transmissivity coefficients are smallest in the direction of strike. The relation of the directional behavior to the structure is of practical significance in locating new wells, to minimize interference. (Gabriel-USGS)
W70-07213

HYDROGEOLOGY OF SOME KARSTIC AREAS OF GREECE,
Food and Agriculture Organization of the United Nations, Athens (Greece).
David J. Burton.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 308-317, 1967. 10 p, 5 tab, 13 ref.

Descriptors: *Hydrogeology, *Hydrologic properties, *Karst, *Groundwater, Fissures (Geology), Limestones, Dolomite, Water circulation, Permeability, Saturated flow, Sea water, Water levels, Springs, Discharge (Water), Drainage, Aquifers, Quaternary period, Water resources, Porosity, Geology, Geochemistry, Transmissivity, Water chemistry.
Identifiers: *Greece, Parnassos-Ghiona area, Argos-Tripolis area, Crete, Kephalonia.

The hydrogeology of fractured rocks of four karstic areas of Greece was investigated. Some of the data obtained were compared with the chemical composition of groundwater in carbonate-aquifers of several circum-Mediterranean countries. The observed permeability variations indicate some primary porosity but the solutionally enlarged fissures through which the groundwater circulates in the carbonate rocks of Greece are joint systems and faults induced by the Alpine orogeny. There are marked chemical and hydrologic differences between the saturated zones perched on impermeable formations and those controlled by the base saturation level. Sea level changes have resulted in several karst levels. Some marine contamination in small amounts has been detected by hydromechanical methods. (Grabriel-USGS)
W70-07214

KARSTIC PHENOMENA IN THE MIOCENE GYPSUMS OF SYRIAN JEZIREH-NORTHEAST SYRIA (IN FRENCH),
Francois Mortier, and Chafic Safadi.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 334-338, 1967. 5 p, 1 fig, 6 ref.

Descriptors: *Karst, *Aquifers, *Gypsum, Water circulation, Geology, Hydrologic properties, Limestones, Water resources, Water sources, Fissures (Geology), Permeability, Geochemistry, Discharge (Water), Water wells, Hydrogeology, Groundwater basins.
Identifiers: *Syria, Jezireh.

Karstic areas of gypsum rocks in northeastern Syria were investigated. The Miocene gypsum and anhydrite formations contain karstic aquifers. Karstification is more common in tectonic zones and low-lying outcrop areas including closed basins and valleys. A method of accelerated dissolution for the development of wells in gypsum areas is briefly described. (Gabriel-USGS)
W70-07215

STUDIES ON THE HYDROLOGY OF FRACTURED ROCKS IN JAPAN,
Tokyo Univ. (Japan).
Soki Yamamoto.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 340-342, 1967. 3 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Hydrologic properties, *Aquifers, *Karst, *Volcanoes, Geophysics, Geology, Mineralogy, Siesmic properties, Seismic studies, Electrical studies, Radioactivity, Core drilling, Discharge (Water).
Identifiers: *Japan, Mt. Fuji, Mt. Aso.

The fractured volcanic rocks of Japan were investigated for the purpose of locating good aquifers by using geological, geophysical (seismic, electric, etc.) and hydrological methods. Many buried valleys formed in mud flows and later covered by lava flows are discharged by several springs. Study of the Mt. Fuji aquifers shows that the springs of the mountain are associated with either perched or buried valley aquifers. (Gabriel-USGS)
W70-07216

THE GROUNDWATER INVESTIGATION IN THE DEVONIAN LIMESTONES, EAST OF ISTANBUL, TURKEY,
Technical Univ. of Istanbul (Turkey). Dept. of Applied Geology.
Kemal Erguvanli.
In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 343-347, 1967. 5 p, 1 fig.

Descriptors: *Aquifers, *Hydrologic properties, *Industrial water, *Water supply, *Water sources, Discharge (Water), Water yield, Geology, Water levels, Geochemistry, Water wells, Groundwater movement, Limestones, Dams, Reservoirs.
Identifiers: *Turkey, Istanbul.

Geological and hydrological characteristics of Devonian limestones located 25 km east of Istanbul, Turkey were investigated during the 1959-1956 period to locate sufficient water for a factory. More than 150 boreholes were made and their water was analyzed for NaCl content. Water yields of 2-3 liters/sec may be obtained; however, the construction of a small dam (10,000 cu m capacity) and the recycling of used water should greatly increase the amount of available water. A detailed geological map of the studied area is included. (Gabriel-USGS)
W70-07217

GROUNDWATER STORAGE PROBLEMS IN SOUTHEAST SPAIN (IN FRENCH),
Agustin Navarro, and Antonio Almela Sampler.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 378-380, 1967. 3 p.

Descriptors: *Groundwater, *Hydrogeology, *Arid lands, *Groundwater basins, *Water storage, Rainfall, Deserts, Precipitation (Atmospheric), Aquifers, Climates, Water resources, Water sources, Dischager (Water), Dolomite, Limestones, Geology, Hydrologic properties, Water wells, Porosity, Fissures (Geology).
Identifiers: *Spain.

The geographical region embracing southeastern Spain is extremely arid with annual rainfall of barely 225 mm. The climate is, however, extremely favorable for high-value cash crops and accordingly the estimation of the groundwater reserves is extremely important. Comparative figures of the percentages of water stored in the various formations of this part of Spain are given. The tectonics, metamorphism and composition are the main factors determining water storage capacity in calcareous terrains. A few concrete cases are given of unsound exploitation which has caused grave damage regionally. Although the figures given are only of real validity for the geological formation and tectonic area specified, they can provide pointers for other rocks and for similar regions. (Grabriel-USGS)
W70-07218

AN EXPERIMENTAL BASIN IN CALCAREOUS FORMATIONS - THE SAUGRAS BASIN, LANGUEDOC, FRANCE (IN FRENCH),
Montpellier Univ. (France), Center of Hydrologic Studies and Research.
C. Drogue.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 381-386, 1967. 6 p, 3 fig, 1 tab.

Descriptors: *On-site investigations, *Aquifers, *Limestones, Dolomite, Springs, Hydrologic properties, Runoff, Water balance, Water storage, Water resources, Hydrologic data, Geology, Hydrogeology, Evapotranspiration, Rainfall, Rainfall intensity, Rain gages, Fissures (Geology), Water sources.
Identifiers: *France, Experimental watersheds, Saugras basin, Languedoc (France).

An experimental basin has recently been installed on a calcareous massif in the south of France. Complete isolation of the aquifer and the localization of springs enables the runoff factor of the water-balance equation to be measured under the best conditions to make it possible to calculate the evapotranspiration characteristic of the type of karst observed here. Study, on a semi-experimental basis, relates the various factors that affect runoff deficit. (Gabriel-USGS)
W70-07219

THE INFLUENCE OF KARST ON THE MAXIMUM FLOW OF THE RIVERS OF THE EAST EUROPEAN PLAINS,
O. L. Markova.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 387-401, 1967. 15 p, 4 fig, 6 tab.

Descriptors: *Karst, *Hydrogeology, *Rivers, Hydraulic properties, Runoff, Drainage, Water storage, Floodwater, Aquifers, Discharge (Water), Geology, Hydrologic properties, Groundwater, Lakes, Swamps, Rainfall-runoff relationships.
Identifiers: *Eastern Europe.

The effect of karst on the maximum river flows was investigated on the basis of geological and hydrological data recorded at the gaging stations located in the plains of Eastern Europe. High accumulation and absorption capacity of karstic formations leads to a decrease of the surface runoff coefficients and flood volumes, carried by karstic rivers. The index of surface runoff decreases and the maximum discharge increases with surface karstic area. Karstic rivers draining basins of over 500 sq km are characterized by runoff indices smaller than 50 or 60. The effect of karst in basins of less than 500 sq km is difficult to identify and, in general, is variable. (Gabriel-USGS)
W70-07220

VESTIGATION OF KARSTIC WATER ESOURCES PRESENT UNDER MIOCENE-LIOCENE-QUATERNARY BLANKET IN THE EDITERRANEAN BASIN AND THEIR MAG-TUDE ON THE BASIS OF SOME RECENT XPERIENCES IN THE LANGUEDOC-ROUS-LLON REGION, FRANCE (IN FRENCH),
ontpellier Univ. (France), Center of Hydrologic udies and Research.
cques Avias.
nglish abstract included. In: Hydrology of Frac-red Rocks, Proceedings of Dubrovnik Symposi-n (October 1965). International Association of ientific Hydrology, Publication No 73, p 410-9, 1967. 10 p, 7 fig, 5 ref.

escriptors: *Karst, *Water resources, *Ground-ater movement, *Water storage, Groundwater, asins, Limestones, Dolomite, Rainfall, Geology, eophysics, Sands, Sandstones, Faults (Geology), ismic studies, Hydrologic properties, Hydraulic operties, Fissures (Geology), Hydrometry.
entifiers: *France, Mediterranean Basin, Lan-edoc-Roussillon.

he limestone-dolomite massifs of the Mediter-nean Basin, characterized by their strong fis-rization and karstification, were investigated by ing geological, geophysical, hydrochemical, and drologic observations. The parts of these massifs at are hidden under miocene-Recent sediments ten constitute excellent water reserves, a fact hich is responsible for the wide application of rious methods in exploration for water in the asin. (Gabriel-USGS)
70-07221

YDROGEOLOGY OF THE VOLCANIC ROCK ORMATIONS OF NORTHEASTERN MOROC-O (IN FRENCH),
Vater Resources Service (Morocco), Dept. of Na-onal Irrigation.
Mortier, T. Nguyen Quang, and M. Sadek.
nglish summary included. In: Hydrology of Frac-red Rocks, Proceedings of Dubrovnik Symposi-n (October 1965), International Association of cientific Hydrology, Publication No 73, p 327-33, 1967. 7 p, 3 fig.

escriptors: *Hydrogeology, *Aquifers, *Igneous ocks, *Basalts, Limestones, Geology, Geologic in-estigations, Geophysics, Water wells, Kolomite, arst, Water chemistry, Water balance, Discharge Water), Fissures (Geology), Hydrologic proper-es, Water levels, Water circulation, Groundwater asins.
entifiers: *Morocco, Oued Isly basin.

ydrologic, geologic, and geophysical data of the ued Isly basin and adjacent areas were analyzed r better understanding of the basin aquifers. asalt and tuffs of Pliocene-Quaternary age form a roundwater conduit about 25 km in length. These oorly-exposed volcanics show a well-established ontinuity, on the basis of geological and geophysi-al data, and may be considered as a single aquifer. hese volcanic rocks conduct groundwater from mestones, located in the upper part of the basin, cross impervious formations to the southern ujda limestones and alluvium of the lower end of e basin. (Gabriel-USGS)
70-07222

ONTRIBUTION TO THE HYDROGEOLOGI-AL STUDY OF LIMESTONE TERRAINS IN .A.R.,
gyptian Desert Inst., Cairo (Egypt). Dept. of ydrogeology.
mail Mahmoud El Ramly.
rench resume included. In: Hydrology of Frac-ured Rocks, Proceedings of Dubrovnik Symposi-m (October 1965), International Association of cientific Hydrology, Publication No 73, p 348-77, 1967. 30 p, 15 fig, 2 tab, 34 ref.

escriptors: *Hydrogeology, *Aquifers, *Karst, Limestones, Geochemistry, Dolomite, Hydrologic properties, Water wells, Fissures (Geology), Fractures (Geology), Transmissivity, Water storage, Groundwater, Climatic data, Geomorphology, Surface waters, Springs, Lakes, Runoff, Precipitation (Atmospheric), Water temperature, Discharge (Water).
Identifiers: *Egypt (UAR), Qattara.

Groundwater reservoirs in fissured limestones of the U.A.R. and the natural lakes of the Qattara Depression located in the western Desert of Egypt were investigated on the basis of geological, hydrogeological, and geochemical data. There is a very close relationship between the distribution of the joint systems and groundwater flows in some areas, and the majority of springs are due to the meteoric waters percolating through joints and solution channels. The temperature of groundwaters from carbonate aquifers varies from 19 deg C to 41 deg C and 3 water types can be identified: these are the chloride, bicarbonate, and sulfate types. (Gabriel-USGS)
W70-07223

THE REGIME OF THE DRYING UP OF LA FOUX DE LA VIS - PRELIMINARY STUDY (IN FRENCH).
J. Forkasiewicz, and H. Paloc.
In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 213-226, 1967. 14 p, 3 fig, 2 tab, 5 ref.

Descriptors: *Groundwater movement, *Karst, *Water circulation, *Flow characteristics, Water sources, Rain water, Precipitation intensity, Groundwater recharge, Dolomite, Geology, Water yields, Caves, Water level fluctuations, Mathematical studies, Hydrograph analysis.
Identifiers: *France, La Foux de La Vis, French Central Massif.

Discharge fluctuations of La Foux de la Vis aquifer, located in the French Centeral Massif, were analytically and experimentally investigated by using hydraulic and hydrologic data recorded from 1950 to 1961. The analysis of the discharge curves, both extrapolated and observed, shows the presence of three distinct discharge velocity decreases; however, the coefficients cannot be considered as entirely reliable for the evaluation of the hydrologic regime. By modifying a formula given by H. Schoeller (1948), the authors find a better and quicker method for the analysis of the regimes of karstic aquifers. (Gabriel-USGS)
W70-07224

SYNTHESIS OF HYDROGEOLOGIC INVESTIGATIONS CONDUCTED IN THE CALCAREOUS ROCKS OF ITALY, (IN FRENCH),
Italian Geologic Service, Rome.
A. Moretti, L. Pannuzi, G. Stampanoni, and N. Zattini.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 293-307, 1967. 15 p, 1 map.

Descriptors: *Hydrologic properties, *Karst, *Groundwater, *Groundwater basins, *Hydrogeology, Limestones, Dolomite, Geology, Structural geology, Water storage, Stratigraphy, Water table, Sea water, Springs, Discharge (Water), Fissures (Geology).
Identifiers: *Italy, Lombardy, Alps, Sardinia, Sicily, The Appennines.

The hydrogeologic characteristics of principal calcareous and dolomitic massifs of Italy, Sardinia, and Sicily are discussed on the basis of a distinction made between the major stratigraphic and structural units and the calcareous complexes forming some parts of the lithologically variable series. Water storage in these rock masses is associated with the regional lithostratigraphic and tectonic conditions and with subsurface and surface factors present in karstic regions. The springs associated with these chiefly Mesozoic rocks often have large and frequent discharges, especially in the central and southern Apennines, and are of overflow of purely karstic type in the calcareous massifs. (Gabriel-USGS)
W70-07225

KARST HYDRODYNAMICS - FLOW AND STORAGE (IN FRENCH),
H. Schoeller.
English summary included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965), International Association of Scientific Hydrology, Publication No 73, p 3-20, 1967. 18 p, 7 fig, 6 tab.

Descriptors: *Groundwater movement, *Karst, *Mathematical studies, Water balance, Water circulation, Calcium carbonate, Springs, Fissures (Geology), Channel flow, Discharge (Water), Water measurement, Water sources, Flow rates, Aquifers, Aquifer characteristics.
Identifiers: *France.

The role of wide and fine channels and fissures in groundwater movement and the recession curves of spring discharges were analytically investigated. Various assumed geological and hydrological conditions of aquifers were calculated and the results compared with the discharge data of the Fontaine de Vaucluse, France, and several aquifers of the Arbailles Napias massif located in the Lower Pyrenees. The discussion includes, (1) discharge under the conditions of a neutral regime; (2) relative independence of various flow systems runoffs and water circulation in a aquifer; (3) water balance in a calcareous massif; (4) conditions induced by infiltration; and (5) calcareous layer with drainage. (Gabriel-USGS)
W70-07226

GEOLOGY AND GROUNDWATER RESOURCES OF THE NORTHERN PART OF THE SALAR DE ATACAMA, ANTOFAGASTA PROVINCE, CHILE,
Geological Survey, Washington, D.C.
Robert J. Dingman.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash. DC 20402. U S Geological Survey Bulletin 1219, 1967. 49 p, 11 fig, 1 plate, 4 tab, 18 ref.

Descriptors: *Groundwater, *Geology, *Water resources, *Arid lands, Water quality, Aquifers, Alluvium, Water wells, Water yield, Hydrologic data, Data collections, Hydrogeology.
Identifiers: *Chile, Antofagasta Province.

The Salar de Atacama is an undrained topographic basin in east-central Antofagasta Province, Chile. The region is underlain by Mesozoic and Cenozoic continental sedimentary rocks, which are divided into four formations, and deposits of ash flows, piedmont deposits, basalt, alluvium, eolian sand, and salt. Aquifers having moderate to large development potential occur in sediments in the basin of the Salar de Atacama. A test drilling program demonstrated that wells flowing as much as 70 liters per second and capable of being pumped at much higher rates could be obtained in the vicinity of San Pedro. The quality of the water, however, is rather poor, the dissolved-solids content is approximately 2,500 ppm and includes 15 ppm of boron. (Knapp-USGS)
W70-07227

AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02A.
W70-07232

OPTIMIZATION OF WELLS AND RECHARGE FACILITIES IN CONJUNCTIVE USE OF GROUNDWATER RESERVOIRS,
California Univ., Davis Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 04B.
W70-07325

LARGEST FLOWING WELL IN CANADA AT FORT ST. JAMES,
Robinson, Roberts and Brown Ltd, Vancouver (British Columbia).
For primary bibliographic entry see Field 04B.
W70-07361

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF THE MISSOURI RIVER ALLUVIUM BETWEEN JEFFERSON CITY AND MIAMI, MISSOURI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-07368

FLOW PROBLEMS IN LIMESTONE PLAINS, JAMAICA, W. I. - A PROGRESS REPORT,
Food and Agriculture Organization of the United Nations (Jamaica).
D. H. Wozab, and J. B. Williams.
French resume included. In: Hydrology of Fractured Rocks, Proceedings of Dubrovnik Symposium (October 1965) International Association of Scientific Hydrology, Publication No 73, p 402-409, 1967. 8 p, 3 fig, 3 ref.

Descriptors: *Karst, *Limestones, *Hydrogeology, Geology, *Groundwater movement, Water sources, Water resources, Groundwater, Swamps, Infiltration, Drainage, Faults (Geology), Evapotranspiration, Precipitation, Rainfall (Atmospheric), Permeability, Water levels, Water level fluctuations, Recharge.
Identifiers: *Jamaica (W I), The Pedro Plains.

The Pedro Plains, located on the southwest coast of Jamaica, comprise a low-lying area of partially karstified limestone terrain which slopes northwards into a wide area of swamp. The limestones are of Lower Miocene age, show a variable lithology, and are extensively faulted along NNW-SSE alignments. Structurally and hydrologically the Plains and the swamp can be considered as a single unit. Rainfall on the Plains average 50 inches, but there is practically no surface drainage. The water table, showing no relationship to topography, is virtually flat, with the exception of mounds along several of the faults. These mounds, together with a marked concentration of groundwater flow towards the north emphasize the influence of structural control on groundwater movement in the Plains. It is tentatively concluded that the source of recharge is external, and reaches the Plains under confined conditions through a faulted and karstified limestone horizon. The unconfined distribution of groundwater is also apparently fault-controlled, although some movement takes place through a previously established system of karst drainage. (Gabriel-USGS)
W70-07404

WATER SITUATION IN MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
Joe W. Lang.
Paper presented at Water Well Symposium, Proceedings Mississippi Society of Professional Engineers, Nov 16-17, 1965, Jackson, Mississippi, published 1967. 13 p, 7 fig.

Descriptors: *Water resources, *Mississippi, *Water Wells, *Hydrogeology, Water resources development, Management, Rainfall-runoff relationships, Water quality, Groundwater basins, Aquifer characteristics, Geologic control.
Identifiers: *Water resources framework.

Describes water-rich characteristics of the State, potential problems for developers and managers of water resources, and need for facts in understanding the environmental framework and the use of water within that framework. Of the annual rainfall (50 inches in the north to 64 inches on the coast) an average of 15 to 20 inches is runoff. The recoverable water supply totals 48 bgd. Except for the Mississippi River along the west boundary, groundwater is the largest most widespread source of fresh water. The 7,000 sq mi Delta is underlain by abundant hard water in the 140-ft section of alluvium; this, the coolest water (63F -66F) is used mostly for irrigation and cooling. Artesian systems in Tertiary and Cretaceous sand aquifers can yield from hundreds to several thousand gpm of soft sodium bicarbonate type water, mostly from depths ranging from a few hundred to more than 2,500 ft. Sand texture usually is medium to coarse, but fine sand is common in many places. Aquifers dip toward the south and west and water quality becomes more saline with depth. Maps show runoff, median dissolved solids at selected sites, areas of geologic sources, and groundwater quality and availability. Two hydrogeologic sections are presented showing electric logs, screen sections in wells, and water quality data. (Lang-USGS)
W70-07405

GEOPHYSICAL INVESTIGATIONS IN ALLUVIAL BASINS IN SOUTHERN ARIZONA,
Arizona Univ., Tucson. Dept. of Geophysics.
John S. Sumner.
Completion Report, (1970). 6 p. OWRR Project A-008-Ariz (1).

Descriptors: *Gravity studies, *Geophysics, Geologic control, Hydrogeology, *Analytical techniques, Exploration, Theoretical analysis, Arizona.
Identifiers: *Alluvial basins.

Geophysical measurements including gravity, magnetic, seismic and electrical exploration techniques have been tried in the alluvial basins of S. Arizona. The object of this work has been to determine the subsurface boundaries of the hydrogeologic basins and the hydrologic parameters of the basins when possible. It can be concluded that the subject geophysical surveys indeed locate the structural boundaries of alluvial basins in S. Arizona. Also, from knowledge of subsurface densities and inferred rock type, estimates of groundwater reserves can be made. Thus the objectives of this research have been largely met in the areas that have been investigated geophysically. The second phase of this research project has been an extension of the geophysical survey work in alluvial basins near Tucson to adjoining areas in S. Arizona. Part of this continuing program is dependent upon gravity data being gathered by the Army Map Service as their part of a joint statewide survey program with the Geophysics Lab at the University of Arizona. Unfortunately their field program has not kept pace, and we are still awaiting their gravity results. An interpretive method for analyzing gravity data has been developed to determine the approximate amount of groundwater in basins and sedimentary valleys. When more gravity survey data becomes available, it will be possible to access the amount of groundwater actually present in these valleys.
W70-07554

2G. Water in Soils

SOME COMMENTS ON REFLECTANCE MEASUREMENTS OF WET SOILS,
National Environmental Satellite Center, Washington, D.C. Satellite Experiment Lab.
For primary bibliographic entry see Field 07B.
W70-07155

A MOVING-BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUS-FLOW SYSTEM,
Stanford Univ., Calif.
George M. Hornberger, and Irwin Remson.
Typescript, 1969. 23 p, 9 fig, 15 ref. NSF Grant 4525.

Descriptors: *Mathematical models, *Flow, *Porous media, *Saturated flow, *Unsaturated flow, Drainage, Water.
Identifiers: *Taylor series method, Finite-difference method.

A moving-boundary model was proposed for one-dimensional transient flow of water through a porous media of which part was saturated and part unsaturated. The model was based upon a theory which implies a discontinuous propagation of pore pressure at the saturated-unsaturated interface. The moving-boundary model was used to study a gravity drainage problem. Two numerical procedures were developed to solve the problem, an approximate Taylor series method and a finite difference method. The validity of the methods was appraised by comparing the results with experimental data given by Watson. The Taylor series method was limited in applicability because of a need for accurate determination of derivations of hydraulic conductivity and of moisture content with respect to pressure head. The finite-difference solution was very efficient because only changes in the unsaturated region were computed and the need for iteration was obviated. (Kriss-Cornell)
W70-07233

EVALUATION OF THE EFFECTS OF REDUCED TRANSPIRATION UPON SOIL MOISTURE RETENTION IN AN ASPEN STAND THROUGHOUT THE GROWING SEASON IN NORTHERN UTAH,
Utah Center for Water Resources Research, Logan.
For primary bibliographic entry see Field 03B.
W70-07331

SOIL SYSTEMS FOR LIQUID WASTE TREATMENT AND DISPOSAL: ENVIRONMENTAL FACTORS,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
For primary bibliographic entry see Field 05D.
W70-07348

ULTIMATE DISPOSAL OF WASTES TO SOIL,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 05E.
W70-07383

2H. Lakes

HIGH-MAGNESIAN CALCITE AND PROTODOLOMITE IN LAKE BALATON (HUNGARY) SEDIMENTS,
Heidelberg Univ. (West Germany). Sediment Research Lab.
For primary bibliographic entry see Field 02J.
W70-07153

PHYSICAL AND CHEMICAL LIMNOLOGY OF TWO MOUNTAIN LAKES IN BANFF NATIONAL PARK, ALBERTA,
Calgary Univ. (Alberta); and Canadian Wildlife Service.
R. Stewart Anderson.
Journal of the Fisheries Research Board of Canada, Vol 27, No 2, p 233-249, 1970. 7 fig, 3 tab, 35 ref.

Descriptors: *Lakes, Limnology, Physical properties, Water temperature, Alpine, Water circulation, Thermal radiation, Thermal stratification, Chemical stratification, Oxygen, Hardness (Water), Hydrogen ion concentration, Nutrients, Light.
Identifiers: Subalpine lakes, Vernal circulation, Trophogenic zone, Banff National Park (Canada).

tudy of an alpine and a subalpine lake revealed hat their vernal circulation does not always reach he bottom, whereas the complete autumnal circu- ation persists for several weeks. The difference in eat incomes of the two lakes was confined to ummer when the alpine lake was cooled by water enewal. The subalpine lake showed a better efined thermal stratification and a very low con- entration of oxygen in deep water strata. Well- efined chemical stratification was of short dura- ion in both lakes. Cloudy ice and deeper snow over of the subalpine lake reduced penetration of isible light. The trophogenic zone extended to the ottoms of both lakes (about 13 meters) for a por- ion of the year. (Wilde-Wisconsin)
W70-07252

RODUCTIVITY OF MACROPHYTES IN MARION LAKE, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Zoology.
Gordon S. Davies.
ournal of the Fisheries Research Board of Canada, Vol 27, No 1, p 71-81, 1970. 6 fig, 5 tab, 13 ref.

Descriptors: *Productivity, *Phytoplankton, Anal- ysis, Bicarbonate, Periphyton, Aquatic plants, Her- bivores, Carbon radioisotopes.
Identifiers: *Macrophytes, Marion Lake (Canada), Sodium bicarbonate, Vascular plants, Lake flush- ng, C-14 analysis, Organic weight method.

A comparison of the relative productivity of macrophytes and phytoplankton was accomplished by C-14 analyses. Paired samples of water were in- oculated with labelled sodium-hydrogen carbonate, ncubated at the depth of collection for 4-6 hours, and the activity was determined at the International Agency for C-14 analyses in Denmark. To deter- mine the uptake of carbon by macrophytes, they were enclosed in Plexiglas chambers with sodium carbonate and following a 4-hour incubation com- busted in oxygen. The carbon dioxide was absorbed n toluene-POPOP-ethanolamine. Radioassay was accomplished by liquid scintillation. The total productivity of the lake was very low, in a large part because of the inhibited development of phytoplankton. Considerable differences were recorded in the estimates of productivity of the macrophytes made by C-14 and organic weight methods, but both analyses indicated that the productivity of macrophytes is always higher than that of phytoplankton. (Wilde-Wisconsin)
W70-07253

EUTROPHICATION, PAST AND PRESENT,
Yale Univ., New Haven, Conn.
G. E. Hutchinson.
Eutrophication: Causes, Consequences, Cor- rectives, p 17-26. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 37 ref.

Descriptors: *Eutrophication, *History, Nutrients, Oligotrophic, Bogs, Color, Turbidity, Cyanophyta, Benthic fauna, Wisconsin, Phosphorus, Drainage, Basins, Sediments, Succession, Chrysophyta, Diatoms, Glaciation, Artemesia, Oak trees, Fir trees, Pollen, Elements (Chemical).
Identifiers: Chironomids, Coregonus, Dinobryon, Yaye Tso (Tibet), Mysis relicta, Green Lake (Wis), Chemical dynamics, Linsley Pond, Trophic equilibrium, Oscillatoria rubescens, Lac de Morat (Switzerland), Lake Llangors (Wales), Pyramid Lake (Nev), Gloeotrichia echinulata, Arthrospira, Lago di Monterosi (Italy).

Definitions of eutrophic, mesotrophic, and oligotrophic as applied to the classification of water types and the concept of classification of lakes based on their drainage basins and sediments form- ing oligotrophic or eutrophic systems are discussed. The stationary concentration of nutrients in as- similable form is of lesser import than the total potential concentration of nutrients and the rate at which it undergoes circulation. Viewing a lake as a dynamic trophic system, circulation speed is equally important as the sum of material available, as well as succession. Extreme oligotrophic lakes are deep and nutrient-deficient, do not produce water bloom, have an orthograde oxygen distribu- tion, a stenoxybiont benthic fauna and Coregonus in the hypolimnion. Eutrophic types are shallow and nutrient-rich, produce water bloom, have a clinograde oxygen distribution, a euryoxybiont Chironomus fauna and no stenotopic hypolimnetic fishes. Whether extreme types of eutrophication are culturally induced or the water bloom is a natu- ral phenomenon based on eutrophic equilibrium is considered. Lago di Monterosi is cited as a case in which cultural eutrophication was initiated by a subtle change in the hydrographic regime. (See also W70-03975). (Auen-Wisconsin)
W70-07262

BACTERIA IN LAKES: POPULATIONS AND FUNCTIONAL RELATIONS,
Wisconsin Univ., Madison.
Elizabeth McCoy, and William B. Sarles.
Eutrophication: Causes, Consequences, Cor- rectives, p 331-339. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 1 fig, 4 tab, 17 ref.

Descriptors: *Bacteria, *Lakes, *Population, *Ecosystems, *Physiological ecology, Microbiolo- gy, Fresh water, Eutrophication, Water pollution, Nitrogen cycle, Nitrification, Nitrogen fixation, Nutrients, Food chains, Temperature, Oxygen, Wisconsin, Sulfur bacteria, Pigments, Fungi, Dys- trophy, Technology, Depth, Bays, Beaches, Sur- faces, Mud, Periphyton, Oligotrophy.
Identifiers: Mesotrophic, Gram-negative, Spirilla, Proteolytic pseudomonads, Eubacteriales, Micromonospora, Streptomyces, Chlamydobac- terales, Beggiatoales, Pseudomonadales, Culture medium, Wisconsin lakes.

Only the so-called natural microflora of freshwater lakes is considered in an attempt to generalize on the probable function of bacteria in biological systems. Bacteria are the prime agents for degrada- tion of dead organic matter to the soluble state, and for the return of soluble organic nutrients to the biological system. By using such nutrients in their own growth, heterotrophic bacteria become par- ticulate matter, are food for protozoa, which in turn are food for higher metazoa, leading ultimate- ly to fish. 'Most probable number' counts for im- portant physiological groups of bacteria in lake flora show that a well-balanced mixture is present to effect degradation of chitin, cellulose, pectins, proteins, and other complex organic compounds. A resolution of the eutrophication problem requires answers to: Does eutrophication involve a change in number or kinds of bacteria within the 'natural' microflora. What is the fate of pollution bacteria in a lake advanced in eutrophication. What needs to be studied on the nitrogen cycle in a eutrophic lake. How important are nitrification and nitrogen fixation in view of recent studies on these bacterial processes. (See also W70-03975). (Jones-Wiscon- sin)
W70-07263

EASTERN EUROPEAN LAKES,
Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
Milan Straskraba, and Vera Straskrabova.
Eutrophication: Causes, Consequences, Cor- rectives, p 65-97. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 11 fig, 4 tab, 127 ref.

Descriptors: *Eutrophication, *Lakes, Water quality, Reservoirs, Oxygen, Nitrogen, Zooplank- ton, Phytoplankton, Fish, Daphnia, Bacteria, Cyanophyta, Biological communities, Benthic flora, Indicators, Chlorella, Oligotrophy, Diatoms, Limnology, Fisheries, Depth, Color, Altitudes, Phosphorus, Biochemical oxygen demand, Chemi- cal oxygen demand, Temperature, Primary produc- tion, Standing crop, Mesotrophic.
Identifiers: *Eastern European lakes, *Europe, Oo- cystis, Crucigenia, Microcystis, Biocenosis, Cladocera, Caspian Sea, Volga River, Relict fauna, Melosira, Coregonus, Coelastrum, Aphanizomenon, Transparency, Renewal time.

Detailed analyses of eutrophication in Eastern Eu- ropean lakes and reservoirs are given. Of primary importance to reservoirs is retention time and hydrology of inflow-outflow and biological proper- ties. These basic differential factors are manifested in water level fluctuations, temperature, and stratification conditions decisive for nutrient utilization by phytoplankton and zooplankton. Un- derstanding these interrelations provides a key to uniqueness of reservoir eutrophication processes. Although known, relation of bacterial increase with increasing pollution has not been proven. Bacterial reproduction increases more rapidly than primary production in comparable waters with increasing eutrophication and is a possible indicator of an al- lochthonous source of organic substances or a rela- tively lower degree of primary production utiliza- tion by zooplankton and consequent availability for bacterial decay. At higher trophic levels, direct relation between water nutrient content, its prima- ry production, and amount of zooplankton seems no longer proportional. Biocenotical interrelations of different trophic links and reciprocal interac- tions must be considered. Influences of nonliving factors--nutrient supply--on primary producers, of primary producers on herbivores, and on through the food chain are recognized. With high fish popu- lations, zooplankton are small Cladocerans and Rotifers; with low, chiefly larger Cladocerans. (See also W70-03975). (Jones-Wisconsin)
W70-07265

THE PROCESS OF EUTROPHICATION IN CENTRAL EUROPEAN LAKES,
Zurich Univ. (Switzerland); and Zurich Univ. (Switzerland). Cantonal Lab.
Eugene A. Thomas.
Eutrophication: Causes, Consequences, Cor- rectives, p 29-49. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 3 fig, 2 tab, 57 ref.

Descriptors: *Eutrophication, *Lakes, Limnology, Oligotrophy, Phosphates, Nitrates, Rain water, Ox- ygen, Calcium carbonate, Seasonal, Depth, Bac- teria, Toxins, Cyanophyta, Cycles, Denitrification, Sewage, Lake morphology, Food chains, Fish, Fer- tilization, Salmonids, Benthic fauna, Domestic wastes, Industrial wastes, Plant growth, Phytoplankton, Pipelines.
Identifiers: *Central Europe, Bavarian lakes, Salz- kammergut lakes, Karnten lakes, Southern Alpine lakes, Savoyan lakes, Swiss midland lakes, Higher Alpine lakes, Europe, Lake sanitation, Cladophora glomerata.

Data from Central European lakes on nitrates and phosphates in surface water during the homother- mic state and the summer stagnation period, the oxygen content in the hypolimnion, and the lime precipitation during summer stagnation is sum- marized. The maximal value of spring quantities of phosphate ions is characterized as the basic value; this basic value decreases to traces or zero during March-June. A lake may have a low basic value of phosphate ions, but high daily phosphate additions may instigate the eutrophication trend. The eutrophication mechanism increases bacterial con- tent, oxygen demand, production of algal growth factors, and algal growth; extent of eutrophication is also indicated by lime precipitation during summer stagnation. With adequate decrease in phosphate addition, basic value of phosphate will decrease. After many years, smaller quantities of phosphates will be offered to algae before the beginning of the vegetative period, and the trophic content of the lake will approximate its original state. (See also W70-03975). (Jones-Wisconsin)
W70-07266

ASIAN LAKES,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
Shoji Horie.
Eutrophication: Causes, Consequences, Correctives, p 98-123. Printing and Publishing Office, National Academy of Sciences, Washington, D.C., 1969. 11 fig, 8 tab, 40 ref.

Descriptors: *Lakes, Eutrophication, Chemical analysis, Benthic fauna, Physicochemical properties, Nitrogen, Diatoms, Dissolved oxygen, Hydrogen sulfide, Rooted aquatic plants, Salmon, Daphnia, Crustaceans, Tubificids, Scenedesmus, Euglena, Cyanophyta, Water pollution effects.
Identifiers: *Asia, Japanese lakes, Lake Suwa-ka (Japan), Lake Haruna-ko (Japan), Lake Yogo-ko (Japan), Lake Biwa-ko (Japan), Lake Kizaki-ko (Japan), Zizania, Phragmites, Potamogeton, Vallisneria, Stephanodiscus, Brachionus, Moina, Closterium, Manchuria, Pediastrum, China, Lamprocystis, Cyclops, Spirulina.

Asian limnology, with the exception of Japan's, has not been studied to a great extent. A distinction is made between global eutrophication--the result of climatic change, and local eutrophication--based on earth movements. Differences in Asian limnology from European and North American are described. Physicochemical properties and plant successions of five Japanese lakes are discussed. In Manchuria, the Brachionus urceus-Daphnia magna appears in polluted waters, with Daphnia carinata and Moina macrocopa where pollution is less severe. Northern mainland Chinese lakes are astatic, scattered in the flood plains of the loess region along the River Huang; they are heavily polluted, become increasingly eutrophic, and finally disharmonic. In developmental history of ancient Japanese lakes, all of which appear harmonic, oligotrophy and eutrophy apparently alternated. Following the classification of Sladecek, increased pollution causes the transition from Limnosaprobitat to Isosaprobitat, when the water contains no dissolved oxygen but a small amount of hydrogen sulfide. Indicative organisms are given. When pollution accumulates past the lake's buffering capacity, it causes a change to Eusaprobitat, accelerating formation of sapropel step by step toward Hypersaprobitat--a process termed sapropellization. (See also W70-03975) (Auen-Wisconsin)
W70-07273

STUDIES ON THE VEGETATION AND HYDROCHEMISTRY OF SCANIAN LAKES I-II,
Artur Almestrand, and Asta Lundh.
Lunds Botaniska Forening, Botaniska Notiser, Supl Vol 2, No 3, p 1-174, 1951. 55 fig, 17 tab, 140 ref.

Descriptors: *Aquatic plants, *Water chemistry, *Ions, *Lakes, Geology, Chemical properties, Physical properties, Bottom sediments, Hydrologic properties, Meteorological data, Vegetation, Distribution, Water chemistry, Sewage, Outlets, Depth, Sea level, Rainfall, Soils, Calcium, Phosphate, Potassium, Temperature, Color, Turbidity, Light penetration, Water level fluctuations, Diatoms, Crustaceans, Chara, Grasses, Iron, Humus, Mosses, Sampling, Hydrogen ion concentration, Manganese, Sewage, Conductivity, Potassium, Chlorides, Sulfates, Nitrates, Phosphorus, Bicarbonates.
Identifiers: *Scanian lakes (Sweden), Sweden, Potamogeton, Reeds, Gyttja, Nymphaeacea, Isoetes, Elodea, Silicic acid, Ceratophyllum.

The variations in flora and their contributing factors were studied in 31 Scanian lakes. Efforts were made to establish characteristic features of electrolyte concentrations and determine whether there is a correlation between ion concentrations and aquatic plant distribution. Ions studied were calcium, magnesium, iron, potassium, chlorine, sulphate, nitrate, phosphate, silicate and bicarbonate. Potassium permanganate consumption, pH, specific conductivity, total solids, non-volatile solids, total hardness and color were also analyzed. Methods are described. The most striking result is the variation in concentration of calcium and bicarbonate; concentrations of other ions more or less agree or the variation is heterogeneous. No apparent differences appear between lakes and aberrant vegetation from the values here given for potassium, phosphorus, and nitrate. The origin of the variant lake vegetation cannot be discovered from an investigation of this type as the salt concentration is only one factor of the large complex forming the environments. It gives no contribution to knowledge of true requirements of individual species. (Jones-Wisconsin)
W70-07275

BIOLOGICAL EFFECTS AND PERSISTENCE OF DURSBAN* IN FRESHWATER PONDS,
California Univ., Riverside. Dept of Entomology; and Bureau of Sport Fisheries and Wildlife, Davis, Calif.
Stuart H. Hurlbert, Mir S. Mulla, James O. Keith, William E. Westlake, and Margaret E. Dusch.
Journal of Economic Entomology, Vol 63, No 1, p 43-52, 1970. 7 tab, 29 ref.

Descriptors: *Insecticides, *Mosquitoes, Ponds, Mallard ducks, Fish, Zooplankton, California, Organophosphorous pesticides, Pesticide kinetics, Ducks.
Identifiers: *Dursban, Mosquitoes, Corisella, Bakersfield (Calif), Cholinesterase activity, Mosquito control.

Dursban (0,0-diethyl 0-3,5,6-trichloro-2 pyridyl phosphoro-thioate) was applied in quadruplicate at two week intervals to small freshwater ponds at rates of 0.01, 0.05, 0.10, and 1.0 lb per acre. The total mortality of mallard ducklings was 42% on treated ponds and zero on control ponds. The rate of application and the mortality of birds showed no relationship. Except for the highest rate of application, the insecticide caused less than 10% mortality of caged mosquito-fish. Fish exposed to 0.05 lb/acre treatment had Dursban residue of 0.1 ppm two weeks after application. Reduction of Corisella population was approximately proportional to the rate of treatment. Several zooplankton species were markedly affected by the insecticide applied at higher rates. The residue of the chemical in vegetation declined rapidly from 26 ppm after 4 hours to 1.1 ppm after 7 days. (Wilde-Wisconsin)
W70-07276

PRIMARY PRODUCTIVITY AND STANDING CROPS OF PHYTOPLANKTON IN BELWOOD RESERVOIR,
Waterloo Univ. (Ontario). Dept. of Biology.
Hamish C. Duthie, and William L. Kirton, Jr.
Canadian Journal of Botany, Vol 48, No 4, p 665-670, 1970. 3 fig, 1 tab, 8 ref.

Descriptors: *Primary productivity, *Reservoirs, *Phytoplankton, Inflow, Standing crop, Photosynthesis, Carbon, Thermal stratification, Productivity.
Identifiers: Activity coefficient, Carbon assimilation, Belwood Reservoir (Canada), Canada.

Primary production and growth features of standing crop recorded at the inflow and near the dam of the Belwood Reservoir, Ontario, are described. While the biomass of standing crop and the rate of assimilation of carbon per square meter were less at the inflow, the activity coefficient was higher than that near the dam. The coefficient varied from 0.19, in sites dominated by Cryptomonas, Asterionella, and Dinobryon, to 0.02, in locations with large population of Ceratium hirundinella. Stands of Peridinium aciculiferum had coefficient of 0.05. Standing crops and activity coefficient were inversely correlated. Estimates of daily production ranged from 134 to 1650 milligram carbon per square meter. (Wilde-Wisconsin)
W70-07277

BENTHIC FAUNA COLONIZATION OF A NEW RESERVOIR WITH PARTICULAR REFERENCE TO THE CHIRONOMIDAE,
Waterloo Univ. (Ontario). Dept. of Biology.
C. G. Paterson, and C. H. Fernando.
Journal of the Fisheries Research Board of Canada Vol 27, No 2, p 213-232, 1970. 7 fig, 4 tab, 24 ref.

Descriptors: *Reservoirs, *Impoundments *Benthic fauna, Succession, Dissolved oxygen Temperature, Sedimentation, Decomposing or ganic matter.
Identifiers: *New reservoirs, Chironomidae Specific conductance, Laurel Creek Reservoi (Ontario), Canada, Colonization.

Two months after filling the Laural Creek Reser voir (Ontario), submerged terrestrial and rheophil ic organisms were largely replaced by limnophili species. By the fourth month the fauna wa dominated by euryoxybiontic limnophiles and b facultative species. In the autumn, the fauna con sisted largely of polyoxybiontic chironomids, an alteration coinciding with siltation and decomposi tion of organic matter. During the second summer most of euryoxybiontic chironomids were replaced by polyoxybiontic forms. The facultative species o the creek fauna were not influenced by the modifi cations of the reservoir habitat. (Wilde-Wisconsin)
W70-07279

SUPERSATURATION OF LAKE WATER WITH A PRECAUTION TO HATCHERY USAGE,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-07310

METEOROLOGICAL RECORDS FOR LAKESIDE, 1968 AND 1969.
State Univ. Coll., Fredonia, N.Y.
For primary bibliographic entry see Field 02B.
W70-07345

RESEARCH TO SAVE AMERICA'S LAKES,
Federal Water Pollution Control Administration Corvallis, Oreg. Pacific Northwest Water Lab.
For primary bibliographic entry see Field 05C.
W70-07393

VERTICAL MIGRATION OF ZOOPLANKTON IN WESTERN LAKE SUPERIOR,
Minnesota Univ., Duluth.
For primary bibliographic entry see Field 05C.
W70-07510

2I. Water in Plants

EVALUATION OF SOIL-APPLIED HERBICIDES FOR VEGETATION CONTROL,
Bureau of Reclamation, Denver, Colo. Office of Assistant Commissioner and Chief Engineer.
For primary bibliographic entry see Field 04A.
W70-07231

AQUATIC BIOLOGY ABSTRACTS, 1969.
For primary bibliographic entry see Field 10.
W70-07370

2J. Erosion and Sedimentation

PLAN AND PROFILE CHARACTERISTICS OF BEACHES IN THE CANADIAN ARCTIC ARCHIPELAGO,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 02C.
W70-07152

HIGH-MAGNESIAN CALCITE AND PROTODOLOMITE IN LAKE BALATON (HUNGARY) SEDIMENTS,
Heidelberg Univ. (West Germany). Sediment Research Lab.
German Muller.
Nature, Vol 226, No 5247, p 749-750, May 23, 1970. 2 p, 2 fig, 5 ref.

Descriptors: *Chemical precipitation, *Lakes, *Sedimentation, *Calcite, *Dolomite, Evaporation, Water balance, Water chemistry, Solutes, Aqueous solutions, Mineralogy.
Identifiers: *Lake Balaton (Hungary).

Recent sedimentation in Lake Balaton, Hungary, is governed chiefly by two processes: (a) Clastic material (quartz, feldspars, calcite, dolomite, phyllosilicates, heavy minerals) introduced by wind and rivers is distributed on the bed by the currents; (b) during the warmer seasons much fine-grained high-magnesian calcite is precipitated from the lake because of the dense and extensive growth of phytoplankton. In photosynthesis carbon dioxide is liberated from dissolved bicarbonate, and carbonate is precipitated. In addition to the clastic dolomite (stoichiometric dolomite), which occurs mainly in the coarse silt, and sand fractions of all sediments, authigenic protodolomite has been detected in the clay fraction of most of the bottom muds. (Knapp-USGS)
W70-07153

SAND WAVES: CAPE HATTERAS, NORTH CAROLINA,
Virginia Univ., Charlottesville.
For primary bibliographic entry see Field 02L.
W70-07154

ORIGIN, CLASSIFICATION, AND GEOLOGIC HISTORY OF CALICHE ON THE SOUTHERN HIGH PLAINS, TEXAS AND EASTERN NEW MEXICO,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
C. C. Reeves, Jr.
Journal of Geology, Vol 78, No 3, p 352-362, May 1970. 11 p, 1 fig, 3 plate, 45 ref.

Descriptors: *Caliche, *Texas, *Soil water movement, *Chemical precipitation, Calcareous soils, Arid lands, Loess, Carbonate rocks, Clays, Hardpan, Soil types, Infiltration, Calcium carbonate, Permeability, Water chemistry, Groundwater movement, Evaporation.
Identifiers: Southern High Plains (Texas).

The caliche profiles on the southern High Plains, Texas and eastern New Mexico, are of Pliocene, Pleistocene, and Holocene age. Differences in age, physical factors, and chemistry allow classification of the caliche into young, mature, and old types. Young caliche is incompetent and powdery except when formed as a laminated zone over an underlying plugged profile. Mature caliche is characteristically nodular, grading downward into old caliche which contains diagenetic quartz. Massive caliches form on semiarid, rapidly aggrading, flat surface of desert loess, on thick calcareous sands providing local climate fluctuates between humid and semiarid, and on near-surface carbonate rocks. The base and sequential development of the caliche are determined by extent and amount of infiltration of water during humid periods following accumulation of calcareous loess, by permeability of the parent material, and by the rapidity of plugging in the caliche profile. Caliche anticlines, or expansion structures, form only in mature caliche or preexisting carbonates. They are formed by expansion of the entire zone caused by filling of horizontal and vertical desiccation cracks by vadose silt and calcareous dripstone. The most intense expansion structures form on interbedded lacustrine clays and sands. Induration of the upper part of a thick caliche results mainly from exposure. Induration of the lower part of the profile included the deposition of diagenetic quartz and carbonate. (Knapp-USGS)
W70-07158

THE AVALANCHING OF GRANULAR SOLIDS ON DUNE AND SIMILAR SLOPES,
Reading Univ. (England). Sedimentology Research Lab.
J. R. L. Allen.
Journal of Geology, Vol 78, No 3, p 326-351, May 1970. 26 p, 10 fig, 3 tab, 24 ref.

Descriptors: *Sediment transport, *Sliding, *Dunes, *Slopes, Friction, Movement, Avalanches, Landslides, Debris avalanches, Mass wasting, Sedimentary structures, Topography, Model studies, Geomorphology, Deltas, Particle size, Particle shape, Talus.
Identifiers: Scree.

Avalanching occurs on slopes underlain by loose granular solids, for example, the slip faces of dunes and deltas and mountain screes, in response to a particle deposition-rate gradient which steepens these slopes to states of instability. The frequency, size, and behavior of the avalanches thus released are shown theoretically to depend on the particle deposition-rate gradient, the particle concentration at the time of deposition, the particle size and density, and the avalanching medium. Experiments made under simplified conditions using natural sands, glass beads, and natural grains provide satisfactory confirmation of major features of the theory. The results are significant for the interpretation of sedimentary structure and landscape form and are consistent with the properties of avalanches observed from experimental sand dunes and mountain screes. (Knapp-USGS)
W70-07160

TIDAL FLAT SEDIMENTATION AT COOLEY LANDING, S. W. SAN FRANCISCO BAY,
San Francisco State Coll., Calif. Dept. of Geology.
For primary bibliographic entry see Field 02L.
W70-07163

INVESTIGATION OF THE DUNE MOVEMENT OF SEDIMENTS ON THE POLOMET RIVER,
Yu. M. Korchokha.
Transl. of Trudy Gos. Gidrol. Institute, No 161, p 98-121, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 541-559, 1968. 8 fig, 7 tab, 33 ref, append.

Descriptors: *Dunes, *Bottom sediments, *Rivers, Flow rates, Waves (Water), Slopes, Sedimentary structures, Hydraulic properties, Streams, Velocity, Sands, Particle size, Channels.
Identifiers: *USSR, *Polomet River, Dune movements.

River-bottom sediments move under the dynamic effect of flow and this movement is accompanied by wavelike bottom deformations. Dune movement of sediments is most clearly represented on the upper slope of a bar. The rate of dune movement is directly proportional to the stream velocity and sediment diameter, and inversely proportional to dune height. The movement of sand dunes is of pulsating nature. The pulsations are produced by large-scale fluctuations in stream velocities. The presence of structural eddy formation that develops in the dune troughs and appears at the surface over the crest of the next dune is a characteristic phenomenon in the Polomet River, USSR. (Carstea-USGS)
W70-07200

THE NATURE AND ORIGIN OF BED-FORM HIERARCHIES,
Reading Univ. (England), Sedimentology Research Lab.
J. R. L. Allen.
Sedimentology, Vol 10, No 3, p 161-182, April 1968. 22 p, 11 fig, 2 tab, 67 ref.

Descriptors: *Sedimentary structures, *Channel morphology, *Alluvial channels, Sediments, Bottom sediments, Open channel flow, Dunes, Ripple marks, Deposition (Sediments), Streamflow, Sediment transport.
Identifiers: Bed-form hierarchies.

The bed forms generated by liquid flows over loose-grain boundaries assume only 2 orientations relative to flow, either transverse or longitudinal, but range enormously in physical scale. Two types of bed form, current ripples and parting lineations, take a characteristic length which is independent of boundary conditions as expressed by flow depth. The characteristic length of other kinds of bed form is correlated with flow depth, according to given equations. From these relationships can be deduced the compositions of theoretical hierarchies of bed forms, where a hierarchy is defined as a series of bed forms graded as to size which in combination are adapted to a single overall flow condition. The compositions of these hierarchies, which are closely matched by naturally occurring hierarchies, are broadly related to available flow depth, general flow conditions (lower or upper regime), and availability of sediment. Bed forms are considered to be due to unstable interactions between the bed material and the over-bed flow of liquid or grains, or both. Hierarchies of bed forms arise because the quantities determining the flow are sufficiently numerous that several mutually unstable combinations can exist, each combination being expressed in terms of a bed form of a characteristic physical scale and orientation relative to flow. (Knapp-USGS)
W70-07211

POSSIBLE SIGNIFICANCE OS TRANSITION FLOW PATTERNS IN INTERPRETATION OF ORIGIN OF SOME NATURAL BED FORMS,
Geological Survey of Israel, Jerusalem.
Iaakov Karcz.
Journal of Geophysical Research, Vol 75, No 15, p 2869-2873, May 20, 1970. 5 p, 36 ref.

Descriptors: *Sediment transport, *Sedimentary structures, *Channel morphology, *Regime, Streamflow, Transition flow, Turbulent flow, Turbulence, Vortices, Eddies, Laminar flow.
Identifiers: Bed forms.

A similarity in morphology and sequence of development seems to exist between some common sedimentary structures and flow configurations encountered in transition and generation of turbulence. The question arises whether such flow instability patterns determine the embryonic configurations of bed deformation, which subsequently develop and grow, thus triggering the appearance of finite size natural bed forms. In the early stage of transition in boundary layer flow over a flat rigid plate, weak, predominantly two-dimensional disturbances appear and are selectively amplified, growing into a pronounced two-dimensional wave pattern. The appearance and the increasing effect of three-dimensional disturbances within the flow result in a regular spanwise distortion of the wave pattern and a corresponding shift in the vorticity alignment, which lead to a fully three-dimensional configuration of flow. Natural, experimentally produced ripples occur in two-dimensional and three-dimensional patterns related respectively to lower and higher energy flows. The embryonic patterns in the higher energy flows, as well as transient ripple patterns (encountered before equilibrium is attained in flows corresponding to a higher stage of flow regime) are basically two dimensional, with some superimposed seminal three-dimensional elements that grow preferentially until the entire pattern becomes three dimensional. (Knapp-USGS)
W70-07352

THE HYPERBOLIC DISTRIBUTION OF PARTICLE SIZES,
Miami Univ., Fla. Inst. of Marine and Atomospheric Sciences.
Henri Bader.
Journal of Geophysical Research, Vol 75, No 15, p 2822-2830, May 20, 1970. 9 p, 9 fig, 4 ref, append.
NONR Grant 4008 (02) 7 (UM7892).

Descriptors: *Particle size, *Mathematical studies, Dusts, Sediments, Grading, Histograms, Suspended load, Suspension, Sedimentology, Turbidity.
Identifiers: Hyperbolic size-distribution.

Many natural collections of small particles, such as cosmic and terrestrial dust, mineral and organic particles suspended in sea water, and fine sediments, have a size distribution well formulated by equations describing hyperbolas. A number of equations are derived for calculating the interesting parameters characterizing hyperbolic distribution, illustrated by new Coulter Counter measurements of dust and sea water. An appendix lists useful equations, generalized for different size parameters. (Knapp-USGS)
W70-07355

AN EXPERIMENTAL INVESTIGATION OF THE VERTICAL MASS TRANSFER OF SUSPENDED SEDIMENT,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Harvey E. Jobson, and William W. Sayre.
In: Proceedings 13th Congress of the International Association of Hydraulic Research, Aug 31-Sept 5, 1969, Vol 2, Subject B, p 111-120, 1969. 10 p, 4 fig, 5 ref.

Descriptors: *Sediment transport, *Suspended load, *Mass transfer, *Hydraulic models, Turbulence, Sands, Silts, Sampling, Settling velocity, Flumes, Suspension, Sediment load.
Identifiers: Turbulent mass transfer.

Vertical turbulent mass transfer coefficients and effective fall velocities for suspended sand particles were determined experimentally in a large laboratory flume by equating the net rate of sediment transfer across planes parallel to the water surface with the longitudinal gradient of sediment flux in the direction of flow, contained in the region bounded by the water surface and the selected planes. The vertical turbulent mass transfer coefficient for fine sand is fairly close in magnitude and distribution to both the mass transfer coefficient for a neutrally buoyant liquid and the momentum transfer coefficient. The mass transfer coefficient for medium sand is somewhat less in magnitude and its distribution is weighted heavily toward the bed. The fall velocity of sand particles is larger in turbulent channel flow than in quiescent water, with the difference more pronounced for the fine than for the medium particles. (Knapp-USGS)
W70-07369

HOT BRINES AND RECENT HEAVY METAL DEPOSITS IN THE RED SEA,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02K.
W70-07394

CHANGES IN NATURAL CHANNELS DOWNSTREAM FROM MAN-MADE RESERVOIRS,
Mississippi State Univ., State College. Dept. of Civil Engineering.
Adnan Shindala, and Melville S. Priest.
Completion Report, April, 1970. 16 p. OWRR Project A-030-MISS (3).

Descriptors: *Degradation (Stream), *Dams, *Stream erosion, Sediment load, Sediment transport, Scour.
Identifiers: *Channel degradation, Scour forecasting.

In general, the study was an anlysis of prototype data for the purpose of determining channel changes downstream from man-made control structures. One part of the study was devoted to changes which occurred in the main stream as a result of man's deliberate alteration of conditions in the upper reaches of a small drainage basin. A second, and more comprehensive, part of the study was devoted to channel changes immediately downstream from very large man-made reservoirs. There has been intense activity in the construction of dams and other control structures in some of the small drainage basins of Mississippi. Some of the changes in the main stream of one such basin were determined from data supplied by several interested federal agencies. As might have been anticipated, peak discharges were somewhat reduced. Changes in cross-section of the main channel depended upon location along the stream. There was a narrowing of the channel in that portion of the stream for which cross-sections were available. Data on channel degradation downstream from large reservoirs were supplied by the Bureau of Reclamation and the Corps of Engineers. Analyses of the data resulted in methods for prediction of the ultimate degradation near the dam, the time required for ultimate degradation near the dam and the distance downstream from the dam to the limit of ultimate degradation. This report consists of four technical papers through which the results of the study have been published. (See also W69-09491 and W70-07520 thru W70-07522).
W70-07519

CHANNEL DEGRADATION DOWNSTREAM FROM LARGE DAMS,
Mississippi State Univ., State College. Water Resources Research Inst.; and Mississippi State Univ., State College. Dept. of Civil Engineering.
Melville S. Priest, and Adnan Shindala.
Water Power, Vol 21, No 11, p 436-437, November 1969. 2 p, 1 fig, 2 ref. OWRR Project No A-030-MISS (3).

Descriptors: *Stream erosion, *Scour, *Dams, *Degradation (Stream), Sediment load, Particle size, Discharge (Water), Streamflow, Bed load, Suspended load, Sediment yield.
Identifiers: *Scour forecasting.

The creation of a large reservoir by obstructing the flow of a natural stream with a dam tends to upset the normal relation between the stream and its channel. If the stream loses a significant sediment load in the relatively quiet waters of a newly created reservoir, it is expected that the stream will react by eroding the channel for some distance downstream from the dam. A practical solution should be possible through analysis of prototype data. Prototype data suitable for analysis seem to be few. However, there are sufficient data available to indicate trends. In order to arrive at a useful solution it is necessary to describe the initial bed materials. This is done from size analyses of the bed materials. Knowing the plan for future release of water from the reservoir and the initial analysis of bed materials, the initial channel cross-section, and the initial stage-discharge relation, the relation given provides a simple means for evaluating the ultimate degradation or lowering of the channel bottom. (See also W70-07519). (Knapp-USGS)
W70-07520

TIME REQUIRED FOR ULTIMATE CHANNEL DEGRADATION DOWNSTREAM FROM LARGE DAMS,
Mississippi State Univ., State College. Water Resources Research Inst.; and Mississippi State Univ., State College. Dept. of Civil Engineering.
Melville S. Priest, and Adnan Shindala.
Water Power, Vol 21, No 12, p 472-473, December 1969. 2 p, 3 fig, 3 ref. OWRR Project No A-030-MISS (3).

Descriptors: *Stream erosion, *Scour, *Dams, *Degradation (Stream), Sediment load, Particle size, Discharge (Water), Streamflow, Bed load, Suspended load, Sediment yield.
Identifiers: Scour forecasting.

An analysis is presented which enables the prediction of time required for ultimate channel degradation downstream of a new reservoir. A qualitative treatment of the time rate of degradation for a reach and the variation in time for ultimate degradation along the channel may be calculated. The physical quantities which appear to be sufficient for an analysis of time for ultimate degradation at a section such as that described in the first paragraph are the ultimate degradation or change in average bottom elevation; the initial grain diameter of bed materials at 50% finer; the initial variation in grain size as described by the standard deviation from diameter between 10 and 90% finer; the average depth of flow through the initial cross-section for the projected average of annual peak values of monthly average discharges; and the acceleration of gravity. (See also W70-07519). (Knapp-USGS)
W70-07521

DISTANCE DOWNSTREAM FROM A LARGE DAM TO THE LIMIT OF ULTIMATE CHANNEL DEGRADATION,
Mississippi State Univ., State College. Water Resources Research Inst.; and Mississippi State Univ., State College. Dept. of Civil Engineering.
Melville S. Priest, and Adnan Shindala.
Proceedings 13th Congress of the International Association for Hydraulic Research Vol 5-1 Kyoto, Japan, September 1969, p 241-243, 1969. 3 p, 1 fig. OWRR Project A-030-MISS (3).

Descriptors: *Stream erosion, *Scour, *Dams, *Degradation (Stream), Sediment load, Particle size, Discharge (Water), Streamflow, Bed load, Suspended load, Sediment yield.
Identifiers: Scour forecasting.

The passage of a sediment-laden stream through a large reservoir may result in velocities so low that virtually all of the stream's sediment load is lost within the reservoir. The release of such sediment-free water from a newly created, man-made reservoir will result in degradation or lowering of the natural channel for some distance downstream from the dam. A method is given for prediction of the distance downstream from the dam to the limit of ultimate channel degradation. The method of prediction proposed is based upon an analysis of prototype data. The physical quantities which are of direct use are the ultimate degradation at a section near the dam, but sufficiently far from it that the flow characteristics are more or less those of a natural stream; the standard deviation of initial bed grain diameter between 10 percent and 90 percent finer from the grain diameter at 50 percent finer, at the same section; and the initial average depth at the same section, for a projected discharge that is the average of annual peak values of monthly averages over a period sufficiently long after closure to allow the limits of ultimate degradation to occur. (Knapp-USGS)
W70-07522

2K. Chemical Processes

ORIGIN, CLASSIFICATION, AND GEOLOGIC HISTORY OF CALICHE ON THE SOUTHERN HIGH PLAINS, TEXAS AND EASTERN NEW MEXICO,
Texas Tech Univ., Lubbock. Dept. of Geosciences.
For primary bibliographic entry see Field 02J.
W70-07158

PHYSICOCHEMICAL CONDITIONS OF FORMATION OF NATIVE ARSENIC IN HYDROTHERMAL DEPOSITS,
Akademiya Nauk SSSR, Moscow. Inst. of Geochemistry.
E. I. Sergeyeva, and I. L. Khodakovskiy.
Transl. from Geokhimiya, No 7, p 846-859, 1969. Geochemistry International, Vol 1969, no 7-8, p 681-694, April 1970. 5 fig, 4 tab, 52 ref.

Descriptors: *Water chemistry, *Chemical precipitation, *Thermal water, *Arsenic compounds, Mineralogy, Geology, Chemical reactions, Thermodynamics.
Identifiers: Hydrothermal deposition, USSR.

According to the Eh - pH diagrams calculated for the system As - H2 O for temperatures of 25, 100, and 200 deg C, separation of native arsenic from hydrothermal solutions is possible only at temperatures below 200 deg C, if the concentration of ar-

senic in the solution is very low, and in the presence of strong reducing agents. The most probable form in which arsenic exists in the hydrothermal solutions is arsenious acid. (Knapp-USGS)
W70-07169

HIGHLY ALKALINE (pH 12) FLUOSILICATE WATERS IN THE DEEPER ZONES OF THE LOVOZERO MASSIF,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
S. R. Kraynov, A. N. Mer'kov, N. G. Petrova, I. V. Baturinskaya, and V. M. Zharikova.
Transl. from Geokhimiya, No 7, p 791-796, 1969. Geochemistry International, Vol 1969, No 7-8, p 635-640, April 1970. 3 fig, 2 tab, 6 ref.

Descriptors: *Water chemistry, *Geochemistry, *Groundwater, Fluorides, Silica, Mine water, Mineralogy, Analytical techniques.
Identifiers: *Lovozero Massif (USSR), Villiaumite.

Groundwaters in the deep zones of the Lovozero alkalic massif are highly alkaline (pH 12) and strongly enriched in fluorine (up to 10-15 g/liter and silica (up to 10-13 g/liter. These waters form as a result of solution of villiaumite (NaF), an abundant mineral in the rocks of the massif. They also contain rather large amounts of aluminum, titanium, niobium, copper, and some other elements. Though the high fluoride content of these waters can be explained by the solution of villiaumite, the high alkalinity and silica, coupled with relatively low carbonate, are most readily attributed to dissolution of primary silicates (principally nepheline) in the absence of atmospheric carbon dioxide. (Knapp-USGS)
W70-07170

SOME PROPERTIES OF WATER AT ELEVATED PRESSURES AND TEMPERATURES,
I. G. Ganeyev, and V. N. Rumyantsev.
Transl. from Geokhimiya, No 7, p 881-890, 1969. Geochemistry International, Vol 1969, No 7-8, p 708-717, April 1970. 8 fig, 30 ref.

Descriptors: *Water properties, *Aqueous solutions, Solutes, Electrolytes, Mineralogy, Water temperature, Water pressure, Quartz, Water chemistry, Solubility, Vapor pressure, Viscosity, Density, Geochemistry.
Identifiers: USSR.

Analysis of published data shows that at elevated pressures and temperatures, density is the principal factor determining the degree of dissociation of water and consequently, the solubility of such difficulty soluble minerals and compounds as silica, aluminum oxide, and others, and of strong electrolytes. The dissociation of strong electrolytes is intimately related to the magnitude of the dielectric constant of water. The mechanism of solution of difficult soluble minerals and compounds in water at elevated pressures and temperatures is discussed with quartz as an example. (Knapp-USGS)
W70-07171

SIMULTANEOUS DETERMINATION OF CARBON AND OXIDABILITY OF ORGANIC COMPOUNDS IN NATURAL WATERS,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
Ye. I. Perel'shteyn, and V. T. Kaplin.
Transl. from Gidrokhimicheskiye Materialy, Vol 46, p 178-181, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 660-663, 1968. 1 fig, 1 tab, 12 ref.

Descriptors: *Analytical techniques, *Organic compounds, *Water quality, Carbon, Ammonium salts, Organic matter, Water analysis.
Identifiers: Ammonium (Potassium) persulfate, Oxidizer.

The determination of organic carbon and oxidability from a single water sample by using ammonium (potassium) persulfate as an oxidizer is described in detail. The sensitivity of the proposed method for determining carbon is 0.5 mg carbon per liter. The accuracy of the method averages 5% for organic carbon and 7-10%, for oxidability. The shortcomings of the most common methods used for determining the oxidability of organic matter in natural waters are also briefly given. (Carstea-USGS)
W70-07201

COMPOSITION OF ORGANIC SUBSTANCES IN THE WATERS OF RESERVOIRS AND LAKES,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
A. D. Semenov, L. I. Nemtseva, T. S. Kishkinova, and A. P. Pashanova.
Transl. from Gidrokhimicheskiye Materialy Vol 46, p 79-84, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 656-660, 1968. 1 tab, 16 ref.

Descriptors: *Water chemistry, *Organic compounds, *Reservoirs, *Lakes, Water quality, Carbohydrates, Aquatic environment, Organic acids, Amino acids, Proteins.
Identifiers: *USSR, Amines, Sugars.

The organic carbon contents of the Rybinsk, Kakhova, Bratsk, Dubossary, and Samgora Reservoirs, and Lakes Baykal, Onega, and Sevan, USSR, were determined in 1965. The total content of nonvolatile organic substances in the investigated water samples of lakes and reservoirs varies in the range 5-60 mg/liter and in each of the water bodies can vary to a greater degree than the total concentration of inorganic substances. The concentration of free amino acids, amines and protein substances is 0.01-0.08, 0.02-0.08 and 0. 3-0. 6 mg/liter respectively. In the composition of substances containing nitrogen the compounds of nonprotein nature predominate. The relatively high content of organic acids (0.06-0. 3 mg equiv/liter) makes it possible to postulate that they play an important role (as do some substances containing nitrogen) in the distribution of forms of migration of microelements, particularly the transition metals. The relation between the concentrations of reducing sugars and complex carbohydrates (polysaccharides) in the water of reservoirs and lakes differs sharply from that in water plant organisms.
W70-07202

FACTORS AFFECTING THE FLUORINE CONTENT IN NATURAL WATERS,
Ye. A. Gel'fer.
Transl. from Gidrokhimiya Materialy Vol 46, p 74-78, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 652-656, 1968. 3 tab, 9 ref.

Descriptors: *Water quality, *Fluorine, *Fluorides, Calcium compounds, Ions, Sulfates, Carbonates, Soils, Carbon dioxide, Calcium Carbonate, Calcareous soils, Magnesium, Sodium, Potassium.
Identifiers: *USSR.

Calcium salts suppress the extraction of fluorine from water-bearing rocks, whereas magnesium salts favor the more complete extraction of fluorine. Increased concentrations of sulfates, Mg, Na, and K in natural water favor enrichment of water with fluorine. The fluorine content in waters whose chemical composition has been modified by human economic activity depends upon the carbonate content of soils and the rocks underlying them as well as on the carbonic acid regime. Carbonic acid dissolves calcium carbonate, and the resulting calcium ions form nearly immobile calcium fluoride by reactions with fluorides. The holding capacity of calcareous soils is often relatively great. (Carstea-USGS)
W70-07204

FACTORS FORMING THE CHEMICAL COMPOSITION OF PRECIPITATION,
Politekhnicheskii Institut, Novocherkassk (USSR).
Ye. V. Posokhov.
Transl. from Gidrokhimicheskiye Materialy, Vol 46, p 15-31, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 640-652, 1968. 62 ref.

Descriptors: *Precipitation (Atmospheric), *Rainfall, *Water chemistry, Water quality, Chemical properties, Precipitable water, Rainfall-runoff relationships, Soils, Orography, Meteorological data, Vegetation effects.
Identifiers: *USSR.

The chemical composition of precipitation is affected by the simultaneous influence of sea, soil, geological, cosmic, orographic, climatic, meteorological, physicochemical, physical and biological factors. However, the relations of these factors are variable. Over the continents, the chemical composition of precipitation is determined by the composition of soils and rocks, presence or absence of vegetation, and by meteorological and orographic factors. The aerosols suspended in the air in coastal regions are of continental-marine origin. Examples-describing the relative importance of different factors upon the chemical composition of precipitation are listed. (Carstea-USGS)
W70-07206

CHEMICAL QUALITY OF RIVER WATERS IN THE NORTHEASTERN USSR,
A. P. Uryvayev.
Transl. from Trudy DVNIGMI, No 26, p 84-94, 1968. Soviet Hydrology: Selected Papers, Issue no 6, p 631-640, 1968. 10p, 2 fig, 5 tab, 5 ref.

Descriptors: *Water chemistry, *Water quality, *Chemical properties, Hardness (Water), Organic compounds, Iron, Calcium, Magnesium, Nitrates, Nitrites.
Identifiers: *Northeastern USSR, Corrosive properties.

Total dissolved solids, water hardness, corrosive properties of water, organic and biogenic substances in water of the northeastern part of the USSR were surveyed. Total dissolved solids does not exceed 200 mg/liter. The relationship between hardness and the total iron, calcium, and magnesium cations is expressed mathematically, but is not valid when the total dissolved solids is below 70 mg/liter and iron content is large. Even a relatively small natural content of iron in surface waters limits their use in many types of activities, ranging from food industry to fisheries. The amount of iron ranged from 0.00 to 10.0 mg/liter. The nitrite ion content in the river water of the northeast was found to be equal to 0.000 - 0.004 mg/liter and only rarely reached values as high as 0.012 mg/liter. The maximum quantity of nitrates was observed during the winter low water, and sometimes during summer low water. (Carstea-USGS)
W70-07208

QUANTITATIVE RELATIONSHIPS BETWEEN MINERALIZATION AND CHEMICAL COMPOSITION OF RIVER WATER IN THE NORTHEASTERN USSR,
A. P. Uryvayev.
Transl. from Trudy DVNIGMI, No 26, p 78-83, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 626-631, 1968. 2 fig, 1 tab, 3 ref.

Descriptors: *Water chemistry, *Water quality, *Chemical properties, Rivers, Dissolved solids, Discharge (Water), High water mark, Meteorological data, Bicarbonates, Ions.
Identifiers: *USSR.

The relationships between mineralization and water discharge of USSR rivers are shown by plotting chemical analysis data against water discharge. In individual years, the curves showing the dependence between mineralization and

discharge have a hyperbolic or complex loop shape. A hyperbolic type of relationship is characteristic of the largest rivers, in which the changes in discharge are smallest. Loop-shaped curves are related to high-water periods. The duration of the periods between high water, and the meteorological conditions during the warm season govern the shape and number of loops. The relationships between the principal compounds of water and mineralization of river waters in the northeast USSR are poorly expressed. Close relationship was noted between mineralization and bicarbonate ion in rivers with primarily bicarbonate-type water. (Carstea-USGS)
W70-07209

ARGON 37, ARGON 39, AND KRYPTON 81 IN THE ATMOSPHERE AND TRACER STUDIES BASED ON THESE ISOTOPES,
Bern Univ. (Switzerland). Physikalisches Institut.
H. H. Loosli, H. Oeschger, and W. Wiest.
Journal of Geophysical Research, Vol 75, No 15, p 2895-2900, May 20, 1970. 6 p, 1 fig, 1 tab, 17 ref.

Descriptors: *Radioisotopes, *Tracers, *Gases, *Atmosphere, *Hydrologic cycle, Argon, Path of pollutants, Air circulation, Groundwater, Surface waters, Groundwater movement, Streamflow, Precipitation (Atmospheric).
Identifiers: Krypton.

Results of monthly measurements of the tropospheric Ar-37 activity during 1969, as well as measurements of the atmospheric activities of the recently detected isotopes Ar-39 and Kr-81 are presented. Applications of these isotopes for tracer studies in the atmosphere and in water reservoirs, for the determination of production rates, and for studying the constancy of the cosmic radiation flux are discussed. (Knapp-USGS)
W70-07248

CONTRIBUTION TO THE RESIDENCE TIME OF SULFUR DIOXIDE IN A POLLUTED ATMOSPHERE,
Federal Board of Health, Berlin (West Germany). Inst. of Water Soil, and Atmospheric Hygiene.
For primary bibliographic entry see Field 05B.
W70-07333

FREEZING TEMPERATURES OF WATER DROPLETS IN EQUILIBRIUM WITH DIFFERENT GASES,
Pennsylvania State Univ., University Park, Pa. Dept. of Meteorology.
For primary bibliographic entry see Field 02B.
W70-07335

TRACE ELEMENT CONCENTRATIONS IN THE TROPOSPHERE AND LOWER STRATOSPHERE.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
L. A. Rancitelli, and R. W. Perkins.
Journal of Geophysical Research, Vol 75, No 15, p 3055-3064, May 20, 1970. 10 p, 1 fig, 6 tab, 20 ref.
AEC Contract AT (45-1)-1830.

Descriptors: *Trace elements, *Aerosols, *Sampling, *Data collections, *Distribution patterns, Air pollution, Dusts, Water pollution sources, Fallout, Sea water.
Identifiers: Air sampling.

A technique was developed and applied to establish the gradient of trace elements from the troposphere through the lower stratosphere. Aerosol collections were made over a two-year period at altitudes of 3 to 15 km between 37 deg N and 46 deg N. The concentrations of Ag, Co, Cr, Fe, Sb, Sc, and Zn measured by instrumental neutron-activation analysis showed gradients of 1-2 orders of magnitude over the altitude range. Concentrations at a given altitude varied as a function of time. A comparison of the relative concentrations observed in the atmosphere with those in metropolitan aerosols, the earth's crust, sea water, and rainwater collected at points remote from possible sources of pollution indicates that, although the atmospheric Fe, Co, and Sc are compatible with the injection of material from the earth's crust, the concentrations of Ag, Cr, Sb, and Zn in the atmosphere are too high to have originated from the natural sources considered. Of 19 elements measured in rainwater, it appears that the only elements that could originate primarily from the oceans are Na, Cl, and Br. (Knapp-USGS)
W70-07338

EVOLUTION OF THE ISOTOPIC COMPOSITION OF ATMOSPHERIC WATERS IN THE MEDITERRANEAN SEA AREA,
Weizmann Inst. of Science, Rehovot (Israel). Dept. of Isotope Research.
J. R. Gat, and I. Carmi.
Journal of Geophysical Research, Vol 75, No 15, p 3039-3048, May 20, 1970. 10 p, 10 fig, 20 ref.

Descriptors: *Stable isotopes, *Radioisotopes, *Tritium, *Precipitation (Atmospheric), Air masses, Climatology, Mass transfer, Winds, Synoptic analysis, Deuterium, Oxygen.
Identifiers: Mediterranean Sea, Oxygen isotopes.

The isotopic composition of rain in the Levant is a reflection of the modification of continental air masses by interaction with the warm Mediterranean Sea. The detailed pattern of evolution of Levantine air was studied by an isotopic survey of rain from 20 coastal and island stations in the eastern Mediterranean Sea area. The changes in tritium, deuterium, and oxygen 18 concentrations as a function of the distance from the coast usually differ from those calculated for a continuous air mass modification model. The major changes occur in the Aegean Sea and along the Turkish coast, in an area of major cyclogenesis. A model of convergent air masses, based on the synoptic patterns, is more consistent with the observed isotopic composition of atmospheric waters in the area. (Knapp-USGS)
W70-07339

INSTRUMENTAL ANALYSIS FOR TRACE ELEMENTS PRESENT IN CHICAGO AREA SURFACE AIR,
Argonne National Lab., Ill. Radiological Physics Div.
For primary bibliographic entry see Field 05A.
W70-07343

ATMOSPHERIC NITROUS OXIDE CONCENTRATIONS IN THE HUMID TROPICS,
National Center for Atmospheric Research, Boulder, Colo.
Miles D. LaHue, John B. Pate, and James P. Lodge, Jr.
Journal of Geophysical Research, Vol 75, No 15, p 2922-2926, May 20, 1970. 5 p, 3 fig, 5 ref. Army Research Office, Contract DAH C04-67-C-0024.

Descriptors: *Air pollution, *Nitrogen compounds, *Oxides, *Water pollution sources, *Tropical regions, Rain forests, Sampling, Data collections, Gas chromatography, Analytical techniques, Instrumentation.
Identifiers: Panama, Barbados.

Nitrous oxide concentrations were obtained from the atmosphere in and above the forests of Panama. Samples were also collected from the coasts of Panama and Barbados for comparison of nitrous oxide levels in Caribbean air with those levels in Atlantic air. Diurnal, climatic, and geographic differences are reported. The system used to collect and analyze the samples is modification of Schutz's method. Gas chromatographic Porapak columns were used in the analysis. (Knapp-USGS)
W70-07344

TRACE METAL CHARACTERIZATION IN AQUATIC ENVIRONMENTS BY ANODIC STRIPPING VOLTAMMETRY,
Bureau of Commercial Fisheries, Ann Arbor Mich., and Michigan Univ., Ann Arbor. Dept. of Environmental Health.
For primary bibliographic entry see Field 05A.
W70-07351

AUTOMATIC METHODS FOR DETERMINING NITRATE AND NITRITE IN WATER AND SOIL EXTRACTS,
Norsk Institutt for Vannforskning, Blindern; and Norges Landbrukshoegskole, Vollebekk.
For primary bibliographic entry see Field 05A.
W70-07358

QUALITY ASPECTS OF FARM WATER SUPPLIES.
Victorian Irrigation Research and Advisory Services Committee, Melbourne (Australia).
For primary bibliographic entry see Field 05G.
W70-07375

HOT BRINES AND RECENT HEAVY METAL DEPOSITS IN THE RED SEA,
Woods Hole Oceanographic Institution, Mass.
Egon T. Degens, and David A. Ross.
New York, Springer-Verlag New York Inc, 1969. 600 p.

Descriptors: *Brines, *Hot springs, *Bottom sediments, *Density stratification, *Mineralogy, Sampling, Sounding, Oceanography, Geochemistry, Geothermal studies, Water chemistry, Aqueous solutions, Saline water systems, Radioactive dating, Radiochemical analysis, Salts, Chemical precipitation, Saline water, Exploration.
Identifiers: *Red Sea, Hot brines.

In the rift valley of the Red Sea, oceanographers found a unique geochemical environment. Several years passed before the significance of the initial finds was fully appreciated. This area is characterized by the presence of hot and saline waters at the bottom of three deeps (water depth about 2,200 meters). Water temperatures are as high as 56 deg C and salinites reach 256 parts per thousand. The water and underlying sediment are generally devoid of any form of life. The sediments and the overlying brines contain abnormally high contents of iron, manganese, zinc, lead, copper, silver and gold. The value of these deposits exceeds 2 billion dollars. In studying this area insight may be gained on the origin of ancient ore deposits of hydrothermal and sedimentary origin. The editors have assembled over 50 papers on th different aspects of the hot brine problem. Chapters deal with regional structure and stratigraphy, local topography and rocks, geomagnetism and gravity, temperatures of water and sediments, movement of the water, chemistry of water and sediments, stable and radioactive isotopes, flora and fauna, comparison with ancient metalliferous strata, and economic and legal factors. (See also W70-07395 thru W70-07402). (Knapp-USGS)
W70-07394

HISTORY OF THE EXPLORATION OF THE HOT BRINE AREA OF THE RED SEA: DISCOVERY ACCOUNT,
National Inst. of Oceanography, Wormley (England).
J. C. Swallow.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 3-9, 1969. 7 p, 5 fig, 11 ref.

Descriptors: *Brines, *Saline water, *Density stratification, *Mineralogy, Sampling, Sounding, Oceanography, Hot springs, Geochemistry, Geothermal studies, Water chemistry, Aqueous solutions, Saline water systems, Salts, Solutes, Chemical precipitation, Bottom sediments, Exploration, Thermal stratification.
Identifiers: *Red Sea, Hot brines.

The RRS DISCOVERY, in exploring the hot brine pools of the Red Sea in 1964, delineated a small area (Discovery Deep) within which a brine with a temperature over 44 deg C was found. In addition, acoustic relecting layers were observed in mid-water in the brine areas during three passages through the Red Sea. These observations include layering in Atlantis II Deep, in November 1963, and a layer observed in April 1967 in a small depression to the south of the previously known brine area. The circumstances surrounding the DISCOVERY's observations and the observations themselves are outlined. (See also W70-07394). (Knapp-USGS)
W70-07395

THE OBSERVATIONS OF THE VERTICAL STRUCTURE OF HOT SALTY WATER BY R. V. METEOR,
G. Dietrich, and G. Krause.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 10-14, 1969. 5 p, 3 fig, 1 tab, 17 ref.

Descriptors: *Brines, *Saline water, *Density stratification, Thermal stratification, Sea water, Water chemistry, Sampling, Geochemistry, Saline water systems, Sounding.
Identifiers: *Red Sea, Hot brines.

On a cruise to the Indian Ocean, R. V. METEOR worked a section through the Red Sea with stations in several deep holes. Hot salty water occurred only in the Discovery Deep (st.28) and in the area of the Atlantic Deep (st.384). The upper limits of the abnormal water were indicated by sound-scattering layers. In both deeps continuous temperature and transparency measurements were carried out. At station 28 the temperature increased with depth within a thermocline of 45-m thickness from 21.6 deg C to 44.8 deg C. At station 384 three layers were observed; the temperature first increased from 21.6 deg C to 41.2 deg C, then to 57.7 deg C and finally to 58.4 deg C near the bottom. At both stations the water was found to be very turbid. The chemical properties of the water are described. (See also W70-07394). (Knapp-USGS)
W70-07396

ATLANTIS II ACCOUNT,
Woods Hole Oceanographic Institution, Mass.
Arthur R. Miller.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea, Springer-Verlag, New York, 1969, p 15-17. 3 p, 8 ref.

Descriptors: *Exploration, *Brines, *Water temperature, *Seawater, Oceanography, Sampling, Sediments, Saline water.
Identifiers: *Red Sea, Hot brines.

A brief account is given of the events leading to and occurring during the 1965 ATLANTIS II trip to the hot brine region of the Red Sea. (See also W70-07394). (Knapp-USGS)
W70-07397

TRACE ELEMENT COMPOSITION OF RED SEA GEOTHERMAL BRINE AND INTERSTITIAL WATER,
University of Southern California, Los Angeles. Inst. of Geophysics and Planetary Physics.
R. R. Brooks, I. R. Kaplan, and M. N. A. Peterson.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 180-203, 1969. 24 p, 7 fig, 4 tab, 14 ref. AEC Contract AT (11-1)34; Project 134.

Descriptors: *Brines, *Trace elements, *Water chemistry, *Hot springs, Sea water, Density stratification, Water analysis, Water temperature, Saline water, Geochemistry, Saline water systems, Chemical precipitation, Bottom sediments.
Identifiers: *Red Sea, Hot brines.

Analytical data are presented for concentration of Na, K, Ca, Mg, Li, Sr, Mn, Fe, Pb, Cu, Zn, Cd, Co and Ni in the brine of Atlantis II and Discovery Deeps and also the interstial water. Enrichment of alkali metals, Ca, Mn, Fe, Pb, Cu and Zn was found in the brine, and Mg was depleted relative to sea water. All metals were enriched in the interstitial water, with the exception of Mg and Fe. The base metals are much more enriched in the interstitial water than the brine. On the basis that trace metal enrichment is higher in brine and interstitial water samples from the Atlantis II Deep than from the Discovery Deep, it is suggested that the source of the brine is derived from beneath the floor at Atlantis II Deep. (See also W70-07394). (Knapp-USGS)
W70-07398

INVESTIGATIONS OF ATLANTIS II DEEP SAMPLES TAKEN BY THE FS METEOR,
Kiel Univ. (West Germany). Geological-Paleontological Inst.
Martin Hartmann.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 204-207, 1969. 4 p, 3 tab, 8 ref.

Descriptors: *Hot springs, *Brines, *Seawater, *Water chemistry, Mixing, Chemical precipitation, Geochemistry, Water temperature, Sampling, Oceanography, Density stratification, Bottom sediments, Mineralogy, Saline water, Sulfides.
Identifiers: *Red Sea, Hot brines.

Information is presented on the geochemistry of the hot brines in Atlantis II Deep. Special emphasis is given to the origin of manganese and iron and to the source of the sulfur species in both sediments and brines. It is concluded that the fractionation of iron and manganese is principally a pH/Eh effect and that the sulfate ions in the brine waters are derived from the overlying Red Sea waters rather than supplied directly by the discharging brines. (See also W70-07394). (Knapp-USGS)
W70-07399

GEOCHEMISTRY AND ORIGIN OF THE RED SEA BRINES,
Scripps Institution of Oceanography, La Jolla, Calif.
H. Craig.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 208-242, 1969. 35 p, 9 fig, 7 tab, 36 ref. NSF Grants G-24479 and GA-666; ONR Grant Nonr 2216 (23).

Descriptors: *Hot springs, *Brines, *Water chemistry, *Sea water, Mineralogy, Aqueous solutions, Saline water, Mixing, Geochemistry, Tracking techniques, Stable isotopes, Radioisotopes, Salts, Salinity, Sulfates, Chlorides, Chemistry, Geothermal studies, Radioactive dating, Density stratification, Density currents, Groundwater movement.
Identifiers: *Red Sea, *Hot brines.

In a steady-state model of the brine waters in Atlantis II Deep, the deuterium and oxygen-18 concentrations in the water and the dissolved argon content suggest a relative warm near surface Red Sea water as the source of the brine. In evaluating the overall environmental situation in the Red Sea in terms of temperature and salinity, the probable source lies about 800 km to the south near the Strait of Bab el Mandeb. By integrating isotope data and the trace and major element spectra of the brine, the origin, age and history of the brine waters are outlined. (See also W70-07394). (Knapp-USGS)
W70-07400

ANOMALOUS STRONTIUM IN THE RED SEA BRINES,
Ohio State Univ., Columbus. Dept. of Geology.
Gunter Faure, and Lois M. Jones.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 243-250, 1969. 8 p, 2 fig, 3 tab, 18 ref.

Descriptors: *Hot springs, *Sea water, *Brines, *Strontium radioisotopes, *Stable isotopes, Geochemistry, Mineralogy, Bottom sediments, Chemical precipitation, Provenance.
Identifiers: *Red Sea, Hot brines.

The hot brines of the Atlantis II and Discovery Deeps of the Red Sea contain strontium of very similar isotopic composition, characterized by an average Sr-87/Sr-86 ratio of 0.7080. This ratio differs significantly from that of normal Red Sea water which has a ratio of 0.7097. The concentrations of strontium in the 56 deg C brine of the Atlantis II Deep and in the 44 deg C brine of the Discovery Deep are very similar and average about 45 ppm. The Sr/Chlorinity ratios of both brines are also similar and average 0.29. The concentrations of strontium, the Sr-87/Sr-86 ratios and the chlorinities of all of the water samples from the Red Sea deeps are consistent with mixing of brine with normal sea water. The Sr-87/Sr-86 ratio of the authigenic minerals of sediment samples from the deeps changes with depth below the sea bottom; at a depth of several meters the ratio of the sediment from both deeps has a value of 0.7112. This may represent the strontium present during the Pleistocene glaciation when the Red Sea was isolated from the open oceans. (See also W70-07394). (Knapp-USGS)
W70-07401

LOW MOLECULAR WEIGHT HYDROCARBON ANALYSES OF ATLANTIS II WATERS,
Naval Research Lab., Washington, D.C. Ocean Sciences Division.
J. W. Swinnerton, and V. J. Linnenbom.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 251-253, 1969. 3 p, 1 tab, 4 ref.

Descriptors: *Brines, *Sea water, *Hot springs, *Organic compounds, Water analysis, Water chemistry, Gas chromatography, Methane.
Identifiers: *Hydrocarbons, *Red Sea, Hot brines.

Preliminary data on the low molecular weight hydrocarbon content in Atlantis II waters are presented. Relative to normal sea waters the low molecular weight paraffins are enriched in the brines by a factor of about 10 to 1,000. The enrichment is most pronounced for methane and ethane. (See also W70-07394). (Knapp-USGS)
W70-07402

ELECTROPHORETIC WATER CLARIFICATION TECHNIQUES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05D.
W70-07512

2L. Estuaries

SAND WAVES: CAPE HATTERAS, NORTH CAROLINA,
Virginia Univ., Charlottesville.
Robert Dolan.
Shore and Beach, Vol 38, No 2, p 22-25, April 1970. 4 p, 2 fig, 7 ref. NPS Contract 14-10-0131-1577.

Descriptors: *Beaches, *Sediment transport, *Littoral drift, *Sand waves, Sedimentary structures, Sand spits, Currents (Water), Sand bars, Dunes, Movement, Geomorphology.
Identifiers: Cape Hatteras (N C), Beach sand waves.

Examination of an aerial photograph of almost any reach of the mid-Atlantic coast shows that the shoreline is seldom straight, but wave-like in plain view. These sinuous forms are called sand waves and they usually occur as fields of parallel points and embayments. The projections and embayments are thought to be shoreline manifestations of complex but systematic transverse bars and troughs that

are common along most sandy coasts. This configuration suggests that the shoreline and inshore parts of the beach respond to a system of interrelated processes, and not as randomly distributed irregularities dependent wholly upon local conditions. In some areas there appears to be a distinct hierarchical arrangement of sand features, with smaller crescentic features grouped within larger ones. Sand wave lengths, defined as the distance between seaward projections, range from 500 to 3,000 ft, with most between 2,000 and 3,000 ft. Sand wave amplitudes, defined as the distance between the innermost part of the embayments and maximum point of the projections, average about 50 to 75 ft; however, large sand waves may reach amplitudes of 125 ft. The rate of migration, which appears to be a function of the energy gradient, ranges up to 600 ft per month. (Knapp-USGS)
W70-07154

TIDAL FLAT SEDIMENTATION AT COOLEY LANDING, S. W. SAN FRANCISCO BAY,
San Francisco State Coll., Calif. Dept. of Geology.
Raymond Pestrong.
Stanford University Technical Report, 1970. 55 p, 23 fig, 4 tab, 22 ref. ONR Contract Nonr-4430 (00), Project NR 388077.

Descriptors: *Tidal marshes, *Mud flats, *Sediment transport, *Deposition (Sediments), Sedimentology, Mud, Sands, Silts, Currents (Water), Waves (Water), Tidal waters, Intertidal areas, Shores, Tidal effects, Wetlands, Deltas.
Identifiers: San Francisco Bay (Calif).

Sediments transported and deposited within the low energy environment of the tidal marshes and mud flats of San Francisco Bay are primarily between 9 and 10 1/2 phi in diameter and are distributed in accordance with a principle of scour and settling lag. The finer sediments are concentrated nearer the higher portions of the tidal flats and marshes where lower ebb flow velocities are unable to transport them farther bayward. Greater quantities of bedload sediment are moved on the flood than on the ebb portions of the tidal cycle both on the tidal flat and through the marsh channel system. Flow conditions peculiar to the marsh-mud flat interface result in the bulk of sedimentation occurring on the uppermost tidal flats, at the base of the marsh. The growth of the tidal channels accompanies the extension of the marsh onto the tidal flat. An equilibrium condition is reached when deposition of sediments at the front of the marsh is matched by erosion of these deposits by the swifter tidal currents that are present as the marsh front approaches the main Bay channel. Higher shear strengths and densities are displayed by the slightly elevated tidal channel levees than by the adjacent mud flats because of the longer periods of desiccation in the levees. (Knapp-USGS)
W70-07163

PHOTOGRAPHIC MONITORING OF SHORELINE MOVEMENT,
Corps of Engineers, Wilmington, N.C.
For primary bibliographic entry see Field 07B.
W70-07164

EUTROPHICATION OF ESTUARIES,
Woods Hole Oceanographic Institttion, Mass.
Bostwick H. Ketchum.
Eutrophication: Causes, Consequences, Correctives, p 197-209. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 5 fig, 7 ref.

Descriptors: *Estuaries, *Eutrophication, *Water pollution effects, Phosphate, Nitrogen, Seawater, Phytoplankton.
Identifiers: New York harbor, Secondary pollution, Hudson River estuary.

The complex characteristics of estuarine circulation provide for both upstream and downstream transport of pollutants. Treatment of domestic sewage to decrease amount of organic matter and biochemical oxygen demand by remineralization may not be effective, since essential nutrients remain in the effluent and may stimulate organic production equal to the organic matter remineralized. Phosphorus and nitrogen are the most common factors which limit marine phytoplankton production. Studies of the relationship between chlorophyll and inorganic phosphate suggest that 2.8 microgram atoms per liter of phosphate is the approximate upper limit for unpolluted water. Beyond this value, insufficient oxygen is present in deep water to oxidize resulting organic production by phytoplankton. Phosphorus values above 2.6 microgram atoms per liter in winter and 1.7 microgram atoms per liter in summer may result in anoxic conditions which will support denitrification, sulfate reduction and the production of hydrogen sulfide. Phosphate concentrations of 1.7 and 2.6 microgram atoms per liter may be considered as conservative danger limits. Controlled fertilization of estuaries is desirable in terms of increased food production; however, the relationships involving conversion of phytoplankton to higher trophic levels are poorly understood and require considerable additional research. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07271

A METHOD FOR PREDICTING POLLUTANT TRANSPORT IN TIDAL WATERS,
Calif., University, Berkeley. Hydraulic Lab.
For primary bibliographic entry see Field 05B.
W70-07366

ESTUARINE POLLUTION IN THE STATE OF HAWAII. VOL. I: STATEWIDE STUDY,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W70-07513

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING DEVELOPMENTS - A PROGRESS REPORT ON DESALINATION,
Water Research Association, Medmenham (England).
M. J. Burley.
Aqua, Issue No 1, London, England, p 23-32, 1970. 10 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Desalination, *Desalination processes, *Reviews, Surveys, Costs, Water treatment, Desalination plants, Distillation, Dialysis, Electrodialysis, Freezing, Reverse osmosis.
Identifiers: Desalination costs.

This paper discusses desalination developments since 1966 and enlarges on some aspects of the use of desalination. Today there are 90 mgd of plant in operation or under construction, and there is every indication that this extremely rapid growth rate will continue. The majority of plant continues to be installed in the Middle East or in island sites such as Malta where conventional water supplies are unavailable or very expensive. Multistage flash (MSF) distillation is the only process in commercial use for sea water desalination although a 0.83 mgd plant using the multiple-effect, long-tube vertical (LTV) process is at present being commissioned. The vacuum freezing process has now been developed to a commercial stage and small units are being marketed. For conversion of brackish water, electrodialysis is the established technique although a number of small reverse-osmosis plants are in operation. At this stage it appears that for feed waters with less than 3,000-4,000 mg/liter TDS electrodialysis is more economic, but for the treatment of higher salinity waters reverse osmosis is cheaper. The vacuum-freezing process has been demonstrated as entirely feasible, and small units are now available. By operating desalination plant in conjunction with conventional water resources according to a planned rule, the effective cost of the increased yield can, in some cases, fall well below the cost of base-load desalination. (Knapp-USGS)
W70-07357

BIOLOGICAL ASPECTS OF THE SALINE WATER PROBLEM,
Philco-Ford Corp., Philadelphia, Pa.; National Institutes of Health, Bethesda, Md.; California Univ., Davis; Harvard Medical School, Boston, Mass; and Yeshiva Univ., New York.
Ross C. Bean, R. Wayne Albers, S. Roy Caplan, Emanuel Epstein, and Robert Katzman.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $0.45. Office of Saline Water Research and Development Progress Report No 513, 1970. 33 p, 1 fig, 20 ref, 5 append.

Descriptors: *Desalination, *Membrane processes, *Biological properties, *Saline water, Desalination processes, Electrodialysis, Dialysis, Osmosis, Reverse osmosis, Ion exchange, Separation techniques.
Identifiers: Biological membranes.

Research on living organisms yielded a background of potentially useful information on desalination membranes. Nature has provided highly efficient mechanisms, in living organisms, for the performance of the exact function desired in desalination-the extraction of ions from water against tremendous chemical potential gradients. Such uphill movement is generally accomplished through the coupling of free energy available from a chemical reaction to the ion movement in the process of 'active transport'. Biological and model systems studied include membrane structure, properties of reconstituted membranes, ionophores, adenosinetriphosphatase ion pumps, organelle transport of water and ions, energetics, enzyme bonding, and effects of ions on molecular structures and interactions. A successful chemodialysis cell may offer considerable advantages over present methods of membrane desalination, and on thermodynamic grounds there is no reason to suppose that the process could not compete economically. (Knapp-USGS)
W70-07376

SECOND REPORT ON HYDRATE REACTION KINETICS AND ICE-CRYSTAL GROWTH RATES,
Syracuse Univ. Research Inst., N.Y.
J. G. Vlahakis, Tsun-chiu Tsao, H: A. Richard, A. J. Barduhn, and S. A. Stern.
Office of Saline Water Research and Development Report No 497, Dec 1969. 44 p, 5 fig, 2 tab, 10 ref. OSW Grant No 14-01-0001-1455.

Descriptors: *Desalination processes, *Hydrate processes, *Kinetics, *Freezing, Hydrates, Separation techniques, Ice, Chemical reactions, Thermodynamic behavior, Water chemistry.
Identifiers: Freon hydrates, Freezing-hydration desalination.

A theoretical model assumes that ice-crystal growth in the direction is entirely heat-transfer controlled, and that all the heat is transferred from the ice crystal to the liquid by convection. The growth rate is predicted to vary as the water flow rate to the 1/2 power and the applied subcooling to the 3/2 power. This prediction has been verified experimentally. At very low subcooled water velocities, the rate of ice-crystal growth is likely to be controlled by heat transfer by axial conduction provided that free convection effects can be neglected; however the convective heat transfer mechanism may control the ice-crystal growth rates at subcooled water velocities as low as 0.2 cm/sec. Freon-31 hydrolysis is a first-order reaction with respect

to the dissolved reactant gas, and is independent of pH. The hydrolysis of Freon-31 was also studied in the presence of metallic iron and copper, which may contaminate the aqueous solutions in a large-scale process. The hydrolysis rate at 34.5 deg C. was unaffected by iron alone or both iron and copper in the reacting solution, but when only metallic copper was present, the rate at 34.5 deg C. increased by nearly 35% after 50 hours and remained essentially constant thereafter. Studies were made on the rates of formation of Freon-31 hydrate in aqueous NaCl solutions. (Knapp-USGS)
W70-07377

OPTIMUM OPERATION OF DESALTING PLANTS AS A SUPPLEMENTAL SOURCE OF SAFE YIELD,
Utah Water Research Lab., Logan.
Calvin G. Clyde, and Wesley H. Blood.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $1.50. Office of Saline Water Research and Development Progress Report No 528, Apr 1970. 125 p, 19 fig, 15 tab, 6 ref, 3 append. OSW Contract No 14-01-0001-1711.

Descriptors: *Desalination plants, *Reservoirs, *Conjunctive use, *Systems analysis, *Computer programs, Mathematical models, Costs analysis, Optimization, Water costs, Reservoir operations, Reservoir design, Design criteria, Design data, Planning, Water supply.
Identifiers: Desalination plant design.

A digital computer program was developed for applying modern operational hydrology to determine the firm yield that will be added by conjunctive use of a desalting plant with another water supply and the associated cost of the firm yield. The principal problem concerns the plant operating rule; i. e., when to turn the plant on and off. The computer program screens the possible operating rules and eliminates those that cannot produce the required water or those that inefficiently produce too much. The remaining rules are then utilized in a cost subroutine that determines the cost of producing the added firm yield. The near optimum rule can then be selected. Using generated hydrologic sequences as an input, the central problem which the computer program must solve is the determination of correct operating rule considering other inputs of demand and cost. Once the correct operating rule is determined, the unit cost of new firm yield is known. Furthermore, a repeated series of computations, each with a different plant size, leads to a choice of a near optimum plant capacity. Similarly, the best reservoir size can be investigated. The unit cost of water from the desalting plants decreased with increasing size and plant factor. When these plants are considered as part of a conjunctive system, a completely different effect on the overall cost of water would result. Only one fuel cost and interest rate is used. Their share (fuel and fixed charges) of the cost can be readily adjusted for other values which, if not greatly different, will still yield reasonable estimates for the total cost of water from these desalting plants. Thus, this information can be used in a wide range of conjunctive water system cost studies. (Knapp-USGS)
W70-07378

DEVELOPMENT OF AN ANALYTICAL MODEL OF A FLASH STAGE - PART II,
Connecticut Univ., Storrs. School of Engineering.
Charles H. Coogan, Jr., David A. Fisher, P. S. Brewster, and H. L. Ornstein.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $1.00. Office of Saline Water Research and Development Progress Report No 503, Dec 1969. 112 p, 35 fig, 92 ref. OSW Contract No 14-01-0001-1240.

Descriptors: *Flash distillation, *Hydraulics, *Fluid mechanics, *Thermodynamics, *Mathematical models, Flow, Jets, Mixing, Turbulence, Evaporation, Turbulent flow, Orifices, Model studies, Mathematical studies.
Identifiers: *Multistage flash distillation, Fluid dynamics.

A simple analytical model was devised to be used in the design of sea water flash evaporators. It provides approximate values of the significant design variables for properly specified input variables, the most significant of which is the liquid quality. The turbulent thermal conductivity is also very significantly affected by the large changes in quality and density which may occur in the jet region. Profiles of temperature, velocity and void fraction, taken throughout the evaporator stage are of value in attempting to improve the simplified flow model. The analytical model requires that a turbulent thermal conductivity be experimentally determined. A flow equation for the simple entrance orifice is proposed which agrees reasonably well with physical data. This equation relates the flow rate per unit area at the orifice to the inlet temperature, thereby relating the flow rate to flashdown for any inlet temperature. The simplified model of a flash stage assumes constant horizontal velocity, level free surface and various entrance temperature distributions. Using a constant value of turbulent thermal conductivity throughout the stage, the evaporation ratio is related to stage length, average liquid depth, and the inverse of the turbulent Peclet Number. A relation between jet flow and turbulent thermal conductivity is postulated. (Knapp-USGS)
W70-07379

REVERSE OSMOSIS PROCESS FOR WATER REUSE APPLICATION,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-07389

DISPOSAL OF EFFLUENTS FROM DESALINATION PLANTS,
Dow Chemical Company, Freeport, Tex.; and Texas A and M Univ., College Station.
For primary bibliographic entry see Field 05E.
W70-07391

3B. Water Yield Improvement

METHOD OF COMPUTING THE DYNAMICS AND YIELD OF SNOW WATER,
For primary bibliographic entry see Field 02C.
W70-07207

EVALUATION OF THE EFFECTS OF REDUCED TRANSPIRATION UPON SOIL MOISTURE RETENTION IN AN ASPEN STAND THROUGHOUT THE GROWING SEASON IN NORTHERN UTAH,
Utah Center for Water Resources Research, Logan.
Michael Zan.
Available from the Clearinghouse as PB-192 221, $3.00 in paper copy, $0.65 in microfiche. Utah State University Center for Water Resources Research Report CWRR-14-2, Masters Thesis in Forest Science, 1968. 50 p, 6 fig, 10 tab, 44 ref. OWRR Project A-004-UTAH (3).

Descriptors: *Transpiration control, *Water yield improvement, *Evapotranspiration control, *Chemcontrol, *Utah, Evaporation control, Transpiration, Evapotranspiration, Water conservation, Vegetation effects, Consumptive use.
Identifiers: Aspen trees, Antitranspirants.

The direct effects of chemically-induced reduced transpiration on soil moisture were studied in a subwatershed of the greater Logan River drainage, Utah. No statistically significant differences occurred among the total amounts of water transpired by the treated and control units. The seasonal low points of soil moisture, in September, showed no significant differences in final moisture retention for the two years studied, either for the control or the treated portions of the study site. The 1967 season showed a lag in soil moisture depletion compared to the 1966 season. Although a later spring in 1967 may have aided in the explanation of this lag, there was good reason to believe that the antitranspirant treatment incurred a significant delay in water use. There was evidence that more effective application of chemicals might have given more positive results. (Knapp-USGS)
W70-07331

SPECTRAL INFRA-RED REFLECTION MEASUREMENTS FROM NATURAL AND TREATED ASPEN FORESTS,
Utah Center for Water Resources Research, Logan.
For primary bibliographic entry see Field 07B.
W70-07332

OPTIMUM OPERATION OF DESALTING PLANTS AS A SUPPLEMENTAL SOURCE OF SAFE YIELD,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 03A.
W70-07378

COMPUTER DETERMINATION OF CLOUD SEEDING AREA OF EFFECT,
North American Weather Consultants, Goleta, Calif.
R. E. Elliott.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 69-74, 1969. 6 p, 3 fig, 11 ref.

Descriptors: *Cloud seeding, *Mathematical models, *Runnoff forecasting, Water management (Applied), Water yield, Water yield improvement.
Identifiers: Cloud seeding models.

Mathematical models used to predict cloud seeding results are briefly reviewed. Most models have been directed toward predicting the lee wave patterns which develop most noticeably under stable air mass conditions. In orographic seeding, major concern is with the flow upwind of crests under unstable to slightly stable conditions. The analytical models provide some useful working parameters involving stability and vertical wind shear in the inflow section. Unfortunately, these parameters change as the air flows over a finite barrier. The solution is the minimum energy solution only in the case of an infinitesimal barrier. It departs most radically from the minimum energy solution in the case of neutral stability, the case of considerable interest to orographic seeding. A dispersal mechanism of controlling importance in much orographic seeding is convection. It is essential to compute a water budget for water in its various forms, vapor, liquid cloud water, cloud ice particles, and precipitation particles within the appropriate mixing mechanism. Growth is very definitely limited by the availability of water. Precipitation particles falling from convection, or from aerial seeding of stratoform cloud, continue to grow and to drift horizontally on descent, and may also be water budget-limited in their growth. A satisfactory numerical model for predicting the area of effect of cloud seeding can be developed on the basis of existing knowledge about mountain air flow, plume dispersal, cloud physics, and water budget. (See also W70-07539). (Knapp-USGS)
W70-07538

AIRBORNE SEEDING TECHNIQUES APPLIED TO WINTER OROGRAPHIC CLOUDS,
EG and G, Inc., Boulder, Colo. Environmental Services Operation.
J. Owen Rhea, and Larry G. Davis.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 75-81, 1969. 7 p, 6 fig, 1 tab, 2 ref. Bureau of Reclamation Contract No 14-06-D-5640.

Descriptors: *Cloud seeding, *On-site investigations, Evaluation, Colorado, Performance, Water yield improvement, Water management (Applied), Testing, Silver iodide, Aircraft.
Identifiers: Aerial cloud seeding application.

Airborne release of seeding material in winter orographic clouds has several advantages over ground-based seeding. These are (1) Partial elimination of necessary reliance on vertical diffusion processes to deliver seeding material to the desired temperature regime; (2) ability to target more accurately based on crystal trajectory calculations; (3) visual observations of cloud coverage from the seeding aircraft (estimates of bases, tops, and orographic characteristics; and (4) airborne monitoring of ice nucleus counts in the seeded area subsequent to seeding release. A study was made of 15 airborne seeding events at the Park Range project, Colorado. Some of the silver iodide particles released serve as ice nuclei in nucleating snow crystals which fall in the target area. Precipitation rate signatures from optical snow sensors frequently reflect the arrival of the seeding effect in the target area in agreement with calculated arrival time. The seeding effect from only a few minutes of AgI release can last for 1 to 4 hours. Pre-flight targeting calculations are sufficiently accurate to allow seeding material release to fall out over most of the primary target area in nearly all cases. (See also W70-07540). (Knapp-USGS)
W70-07539

3C. Use of Water of Impaired Quality

WASTEWATER REUSE - A SUPPLEMENTAL SUPPLY,
Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 05D.
W70-07151

3E. Conservation in Industry

THE CHARACTERISTICS AND POLLUTIONAL PROBLEMS ASSOCIATED WITH PETROCHEMICAL WASTES, SUMMARY REPORT,
Engineering-Science, Inc. Texas, Austin.
For primary bibliographic entry see Field 05D.
W70-07511

3F. Conservation in Agriculture

THE DEVELOPMENT OF A MODEL TO EVALUATE HYDROLOGIC RISK IN A WATER RESOURCE SYSTEM,
Battelle Memorial Inst., Richland, Wash.; and Texas A and M Univ., College Station.
For primary bibliographic entry see Field 04A.
W70-07246

ECONOMIC VALUES OF IRRIGATION WATER IN FOUR AREAS ALONG THE SNAKE RIVER IN IDAHO.
Idaho Agricultural Experiment Station, Moscow.
Karl Lindeborg.
Available from the Clearhouse as PB-192 117, $3.00 in paper copy, $0.65 in microfiche. Idaho Agricultural Experiment Station, Idaho University, Bulletin 513, January 1970. 27 p, 5 fig, 14 tab, 4 ref, append. OWRR Project A-017-IDA (1).

Descriptors: *Irrigation water, *Economics, *Value, *Water values, Cost-benefit analysis, Prices, Pricing, Computer programs, Linear programming, Mathematical models, Systems analysis.
Identifiers: Snake River (Idaho).

Four areas in Southern Idaho were included in a study of irrigation water value. Information collected by personal interviews included physical as well as economic data pertaining to input and output of the main crop enterprises. The economic models used in estimating the value of water were based on partial farm budgeting and linear programming. Included in the economic models were variables of farm size, farm organization, water supply, and restraints on acreage. The first linear programming model was designed for a fixed water supply for three representative farms of 320 acres each. The price of water common to the 3 areas was $27.24 for the last acre-foot of water. A second parametric programming model was designed for a variable supply of water. The restraints were the same as in the first model. The results of this model were a range of Marginal Value Products for each of the crop enterprises in each of the 3 areas. A third parametric model was used for different-sized farms in 2 areas. The results showed an increasing ability to pay for water with increasing farm size. (Knapp-USGS)
W70-07334

QUALITY ASPECTS OF FARM WATER SUPPLIES.
Victorian Irrigation Research and Advisory Services Committee, Melbourne (Australia).
For primary bibliographic entry see Field 05G.
W70-07375

BUREAU OF RECLAMATION PUMPED STORAGE PLANTS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 08C.
W70-07432

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

OPTIMAL RESERVOIR RELEASES FOR WATER QUALITY CONTROL,
Federal Water Quality Administration, Annapolis, Md. Chesapeake Technical Support Lab.; and Michigan Univ., Ann Arbor. Dept. of Sanitary and Water Resources Engineering.
For primary bibliographic entry see Field 05G.
W70-07150

FLOOD PLAIN INFORMATION, ST. CHARLES RIVER, PUEBLO, COLORADO.
Corps of Engineers, Albuquerque, N. Mex.

US Army Corps of Engineers Flood Plain Report, March 1970. 35 p, 5 fig, 24 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Colorado, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: St. Charles River (Colo), Pueblo (Colo), Standard project flood, Intermediate regional flood.

Flooding of the St. Charles River, Pueblo, Colorado is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07161

FLOOD PLAIN INFORMATION, MINGO CREEK, TULSA, OKLAHOMA.
Corps of Engineers, Tulsa, Okla.
US Army Corps of Engineers Flood Plain Report, March 1970. 32 p, 7 fig, 18 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *Oklahoma, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Tulsa (Okla), Mingo Creek (Colo), Standard project flood, Intermediate regional flood.

Flooding of Mingo Creek, Tulsa, Oklahoma is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07162

THE APPLICATION OF CONCEPTUAL CATCHMENT MODELS TO RIVER FORECASTING,
Weather Bureau, Silver Spring, Md.
T. J. Nordenson.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 181-192, 1969. 12 p, 16 ref.

Descriptors: *Mathematical models, *Streamflow forecasting, *Simulation analysis, *Synthetic hydrology, *Reviews, Streamflow, Flood forecasting, Data processing, Digital computers, Computer programs, Water management (Applied), Routing, Water resources development.
Identifiers: Watershed models, River forecasting.

The application of conceptual catchment models to river forecasting is described. River forecasting is defined as the simulation of the streamflow hydrograph. The simulation of streamflow is a vital requirement in developing comprehensive water-resource plans to fulfill the needs of navigation, municipal and industrial water-supply, irrigation, hydro-electric power, flood control, watershed protection and management, and recreational activities. The models described are the Stanford Watershed Model, the Utah State Simulation Model, the Agricultural Research Service Model, the Columbia River Basin Model, the U.S. Weather Bureau model, the API model, and Soil-moisture accounting. (Knapp-USGS)
W70-07183

SHORT-TERM FLOOD FORECASTING WITH THE RETENTION MODEL,
New South Wales Univ., Kensington (Australia).
F. C. Bell.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 193-207, 1969. 15 p, 6 fig, 4 tab, 9 ref.

Descriptors: *Flood forecasting, *Runoff forecasting, *Mathematical models, *Simulation analysis, *Rainfall-runoff relationships, Model studies, Water storage, Infiltration, Overland flow, Base flow, Soil moisture, Open channel flow, Streamflow.
Identifiers: Retention model.

In the retention model for short-term flood forecasting, a catchment is regarded as an interconnected system of catchment units and channel units. The number of units desirable for larger catchments depends on storm characteristics, soil/vegetation heterogeneity and the amount of data available. Each catchment unit consists of a retention storage and a runoff storage. The retention storage is the water in the catchment that is unlikely to become streamflow, namely the 'capillary'

soil moisture, precipitation intercepted by vegetation, and some parts of the depression, groundwater and channel storages. The runoff storage consists of overland flow, 'free' water moving through soil or litter, groundwater, and storage in minor channels. Channel units are intended to simulate the effects of the major stream channels in conveying the runoff from the runoff storages to the catchment outlet. The total operation of the model requires a separate accounting procedure for each retention and runoff storage during both wetting and drying phases. This allows for the effects of area variability, especially in precipitation. The outflows from each runoff storage are appropriately combined in the channel units and the outflow from the final channel unit represents the stream flow at the catchment outlet. The retention model appears suitable for short-term flood forecasting, and may have special advantages for large and variable catchments. Although its operational elements are simpler and more flexible than those of other conceptual models, it maintains a reasonable degree of physical reality and should therefore be reliable under a wide range of conditions. (Knapp-USGS)
W70-07184

FLOOD FORECASTING AND CONTROL OF THE LEVEL OF LAKE BURLEY GRIFFIN,
Commonwealth Dept. of Works, Canberra (Australia).
B. J. Fitzgerald.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 227-241, 1969. 15 p, 10 fig, 3 ref.

Descriptors: *Flood forecasting, *Telemetry, *Routing, *Flood protection, Water levels, Reservoirs, Flood control, Reservoir operation, Reservoir design, Water management (Applied).
Identifiers: Lake Burley Griffin (Canberra-Australia).

Lake Burley Griffin is an artificial lake for ornamental and recreational purposes in the heart of Canberra, Australia. As the lake is located in the heart of Canberra and has numerous buildings and public gardens on its shores, warning of forthcoming floods, control of flood levels in the lake and of releases of flood flows from Scrivener Dam are essential for the safety of the public and for avoiding or minimizing flood damage in the vicinity. During the planning of the lake, investigations were carried out to determine the degree of control of the water-level that should be practicable during a flood, and the network of water-level telemetering stations that would be necessary both upstream and in the lake. This paper describes the network of telemetering stations; the flood-warning time provided by these stations; the methods of determining flood flow rates; operational procedures for controlling the lake-level by release of flood flows through the Scrivener Dam flood gates; procedures for ensuring public safety and minimizing flood damage both upstream and downstream of Scrivener Dam; and the degree of control of the lake water-level that should be practicable. With this network, taking into account the relative simplicity of computing inflow and releases, it is practicable to pass floods of up to 30,000 cusecs through Lake Burley Griffin and still maintain the level in Central Basin within a few inches of normal. If a flood were to exceed 80,000 cusecs the lake walls would probably be overflowed. It should be possible to forecast at least six hours in advance if floods are likely to exceed 80,000 cusecs. (Knapp-USGS)
W70-07185

SEASONAL LOW-FLOW FORECASTING,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-07186

FLOOD-FORECASTING FROM DISCHARGE DATA IN DRAINAGE NETWORKS AND FROM PRECIPITATION,
For primary bibliographic entry see Field 02E.
W70-07188

FLOOD PLAIN INFORMATION, PENNSAUKEN CREEK AND SOUTH BRANCH, BURLINGTON AND CAMDEN COUNTIES, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

US Army Corps of Engineers Flood Plain Report, July 1969. 43 p, 7 fig, 12 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Burlington County (NJ), Camden County (NJ), Standard project flood, Intermediate regional flood.

Flooding of Pennsauken Creek and South Branch, Burlington and Camden Counties, New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07192

FLOOD PLAIN INFORMATION, LITTLE LA GRUE BAYOU, HOLT QUERTERMOUS AND PRICE BRANCHES, DEWITT, ARKANSAS.
Corps of Engineers, Memphis, Tenn.

U S Army Corps of Engineers Flood Plain Report, June 1969. 46 p, 7 fig, 12 plate, 14 tab.

Descriptors: *Floods, *Flood damage, *Arkansas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *DeWitt (Ark), Standard project flood, Intermediate regional flood.

Flooding in DeWitt, Arkansas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07194

MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, CASSVILLE, WISCONSIN.
Corps of Engineers, Rock Island, Ill.

U S Army Corps of Engineers Flood Plain Report, June 1969. 60 p, 26 fig, 7 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Wisconsin, *Mississippi River, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Cassville (Wis).

Flooding of the Mississippi River, Cassville, Wisconsin is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07197

FLOOD PLAIN INFORMATION, WABASH RIVER AND WILDCAT CREEK, VICINITY OF LAFAYETTE AND WEST LAFAYETTE, TIPPECANOE COUNTY, INDIANA.
Corps of Engineers, Louisville, Ky.

U S Army Corps of Engineers Flood Plain Report, December 1968. 45 p, 13 fig, 17 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Indiana, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Wabash River, Tippecanoe County (Ind), Standard project flood, Intermediate regional flood.

Flooding of the Wabash River, Tippecanoe County, Indiana is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07212

EVALUATION OF SOIL-APPLIED HERBICIDES FOR VEGETATION CONTROL,
Bureau of Reclamation, Denver, Colo. Office of Assistant Commissioner and Chief Engineer.
N. E. Otto.
For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC, 20402 - Price $0.45. Research Report No. 22, Water Resources Technical Publication, 1970. 31 p, 12 tab, 15 fig, 17 ref, append.

Descriptors: *Weed control, *Soil-sterilants, Herbicides, Weeds, Soil treatment, Vegetation, Operation and maintenance, Performance tests, Field tests, Solubility, Chemicals, Statistical analysis, Semiarid land, Plant (Botany), Alluvial deposits, Atmospheric precipitation, Research and development, Organic compounds, Soil-water-plant relationships.
Identifiers: Nonselective herbicides, Root zone, Uracil herbicides, Triazine herbicides, Substituted urea herbicides, Chlorate-borate herbicides.

Twenty-seven soil-applied herbicide formulations were evaluated for ability to provide complete vegetation control in an arid area. Observational ratings of test plots indicate that the herbicides prometone and isocil consistently produced the best over-all plant control at median and high rates of treatment over a period of 5 years. Diuron provided excellent control at the high rate only. Low-rate applications were not effective beyond 3-years' exposure. Bromacil was evaluated subsequent to the initial 5-year test and found to be equal to isocil. Granular formulations of prometone, atrazine, and bromacil were equally as effective as the wettable powder formulations. Atrazine, monuron, 3-herbicide formulations containing mixtures of chlorates, borates, and substituted ureas produced notable vegetation control for 3 to 5 years, but with variable results. A summary of over-all performance of each herbicide and rate of application is presented. The report contains an appendix summarizing the results of a survey on annual soil-sterilant use on Bureau of Reclamation projects. This study was conducted to provide information useful to project operating personnel for improving recommendations and selection of herbicides for long-term vegetation control.
W70-07231

A MOVING-BOUNDARY MODEL OF A ONE-DIMENSIONAL SATURATED-UNSATURATED, TRANSIENT POROUSdFLOW SYSTEM,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02G.
W70-07233

RECENT ADVANCES IN STORAGE AND FLOODING THEORY,
Office of Naval Research, Washington, D.C.
J. Gani.
Advances in Applied Probability, Vol 1, No 1, p 90-110, Spring 1969. 1 fig, 34 ref.

Descriptors: *Mathematical models, *Floods, *Storage, *Research and development, *Dam design, *Time, River flow.
Identifiers: Markov chains.

A variety of storage and flooding models and problems were presented along with a discussion of current directions of research in the field. Specifically, the time-dependent theory of Lloyd's infinite dam and finite dam and Moran's formulation of a discrete finite dam model were outlined. Further, a brief outline of Ali Kahn's and the author's own time-dependent extension of this approach were given. A description of the problem of estimating the distribution of largest monthly floods from limited runs of river flow data considered by Moran was outlined along with the problem of regulating the flow of two confluent rivers by a dam, considered by Anis and El-Naggar. Flow regulation models and sequential methods in storage were also discussed. (Kriss-Cornell)
W70-07236

THE DEVELOPMENT OF A MODEL TO EVALUATE HYDROLOGIC RISK IN A WATER RESOURCE SYSTEM,
Battelle Memorial Inst., Richland, Wash.; and Texas A and M Univ., College Station.
William L. Bathke, and R. J. Freund.
Water Resources Bulletin, Vol 5, No 1, p 53-61, March 1969. 3 fig, 15 ref.

Descriptors: *Risks, *Hydrologic aspects, *Simulation analysis, *Computers, *Optimization, Reservoir design, Irrigation design, Texas, Water shortage, Benefits.
Identifiers: Twin Buttes Reservoir, South Concho River.

A technique for determining optimal combinations of reservoir size and irrigation development levels, with the optimum being adjusted for the effects of a highly variable water inflo, i.e., hydrologic risk, was described. The technique determined, by computer simulation, the net benefit from a selected reservoir size and irrigation development level. The method also took into account the economic loss in revenue due to tolerable water shortages. Data from the Twin Buttes Reservoir on the South Concho River to West Central Texas was used. A preliminary study of the watershed was made to determine feasible combinations of irrigation development levels and reservoir size. A region of tolerable water shortages was computed and used as a basis for determining an experimental design of combinations whose operating characteristics were simulated from an actual 39-year record of streamflow. A three-dimensional economic loss function was derived to represent more efficiently the penalty assessment for tolerable water supply deficits due to the changes in irrigation patterns associated with project development size. A response surface of net benefit was then fitted to the resulting net benefits of the various design combinations. Standard response surface technology was used to derive the optimum combinations for a desired irrigation development level. The methodology was said to be readily adaptable to more complex situations involving irrigation needs, evaporation and seepage losses, municipal water needs, flood control benefits, and economic risk due to price fluctuations in agricultural commodities produced by the irrigated land. (Kriss-Cornell)
W70-07246

PERIODIC MARKOV PROGRAMMING,
Queen's Univ., Kingston (Ontario). Graduate School of Business.
E. R. Peterson.
Journal of Canadian Operational Research Society, Vol 7, No 1, p 39-44, March 1969. 5 ref.

Descriptors: *Markov processes, *Optimization, *Time, Streamflow, Dynamic programming, Linear programming, Hydroelectric plants, Reservoirs.
Identifiers: Policy-iteration method.

A method that converges monotonically to an optimal policy for periodic Markov chains with return was developed. This was an extension of Howard's policy-iteration method and represented an alternative method to one developed by Riis which combined policy-iteration and the method of successive approximations of dynamic programming. Computationally the most time-consuming step in the policy-iteration method was solving the set of linear equations or for the value of a policy for the states in class. A hydro-electric system, where the reservoirs were usually full at the end of the high summer runoff provided an example. The concept of 'one-step transient state' was introduced to reduce the dimensionality of the optimization problem which greatly reduced the computation required. To emphasize the computational importance of determining the one-step transient states, the computation time was reduced by a factor of approximately eight in examples based on a hydro-electric system with a conditional streamflow model. (Kriss-Cornell)
W70-07249

KEENER V SHARP (RIGHT TO INSTALL WATERGATE AND OBSTRUCT FLOW THROUGH BAYOU).

111 SW2d 118-121 (Mo 1937).

Descriptors: *Missouri, *Natural streams, *Surface waters, *Bayous, Obstruction to flow, Judicial decisions, Watercourses (Legal), Dam construction, Flow control, Channel flow, Lakes, Riparian land, Riparian rights, Remedies, Rivers, Mississippi River, Overflow, Natural flow, Proprietary power, Repulsion (Legal aspects), Streamflow, Surface runoff.
Identifiers: *Watergates.

Defendants built a watergate in a bayou which connected a lake with the Mississippi River. The installation of the watergate caused water to rise in the lake and flow onto lands of the plaintiff, who owned property along the lake. Plaintiff brought an action to have the gate removed. Defendants contended that the water in the lake and the overflow therefrom constituted surface water which defendants were entitled to ward off their land along the bayou. The court acknowledged the common enemy doctrine that permits a landowner to ward off surface water from his property onto that of adjacent owners. However, the court held the lake was not surface water even though it occasionally became dry. In holding for plaintiff, the court stated that natural streams cannot be diverted to the damage of another's property without compensation. The bayou possessed the characteristics of a natural watercourse since it had well-defined banks, a channel, and contained running water most of the year. Therefore, the court ordered the removal of the watergate. (Hubener-Florida)
W70-07281

MAGARO V METROPOLITAN EDISON CO (DISCHARGE OF COLLECTED WATER ONTO LOWER LAND).

197 A 550-552 (Penn 1938).

Descriptors: *Pennsylvania, *Artificial watercourses, *Impounded waters, *Riddance (Legal aspects), Damages, Legal aspects, Judicial decisions, Bodies of water, Watercourses (Legal), Canals, Banks, Maintenance , Repairing, Floodwater, Land tenure, Land use, Overflow, Surface waters, Drains, Soil, Crops, Natural flow, Impoundments, Surface runoff.

Defendant had acquired a strip of land above plaintiff on which there was a canal formerly maintained by the previous owner. A drain from the canal discharged water into a natural watercourse. Defendant continued to maintain the drain; however, accumulated water washed out part of the canal banks and discharged an increased quantity into the natural watercourse. As a result, the watercourse overflowed and damaged plaintiff's land. In the trial court, plaintiff alleged permanent damages due to defendant's negligence in permitting the discharge of water to overflow her land. Judgment was for plaintiff, and defendant appealed. The Superior Court of Pennsylvania affirmed. The defendant was not obliged to maintain the canal, but it had acquired land with artificial banks which gathered and collected water. Such water in its natural state would not have flowed there. Defendant could not without liability permit this increased quantity of water to be discharged in a manner injurious to plaintiff's land. Plaintiff could not object to receiving water which would naturally come on her land from higher ground, but this did not justify defendant in collecting water that would flow elsewhere and discharging it onto plaintiff's land. (Duss-Florida)
W70-07282

FLOOD PLAIN INFORMATION, DAN AND SANDY RIVERS AND SANDY CREEK, DANVILLE, VIRGINIA.
Corps of Engineers, Wilmington, N.C.

U S Army Corps of Engineers Flood Plain Report, January 1970. 52 p, 12 fig, 30 plate, 19 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Dan River (Va), Sandy River (Va), Danville (Va).

Flooding of the Dan and Sandy Rivers and Sandy Creek, Danville, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07347

FLOOD PLAIN INFORMATION, CEDAR RIVER AND TRIBUTARIES, AUSTIN, MINNESOTA.
Corps of Engineers, Rock Island, Ill.

U S Army Corps of Engineers Flood Plain Report, June 1969. 72 p, 64 fig, 15 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Minnesota, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Austin (Minn), Cedar River (Minn), Standard project flood, Intermediate regional flood.

Flooding of the Cedar River, Austin, Minnesota is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07372

LOOD PLAIN INFORMATION, ROCK RIVER, VINNEBAGO, ILLINOIS.
Corps of Engineers, Rock Island, Ill.

'S Army Corps of Engineers Flood Plain Report,)ec 1969. 80 p, 60 fig, 18 plate, 11 tab.

)escriptors: *Floods, *Flood damage, *Illinois, lood plains, Flood control, Non-structural alter-atives, Maximum probable flood, Historic flood.
dentifiers: Rock River (Ill), Winnebago County Ill), Standard project flood, Intermediate regional lood.

looding of Rock River, Winnebago County, Il-nois is described in a report of flood plain roblems based on records of rainfall, runoff, and istorical and present flood heights. Maps, photo-raphs, profiles, and cross sections indicate the ex-ent of flooding that has occurred and which may e expected to occur in the future. The information s for use in study and planning ways to minimize ulnerability to flood damages by control of flood lain use by zoning and subdivision regulations, the onstruction of flood protection works, or by com-inations of these approaches. (Knapp-USGS)
W70-07373

SPECIAL FLOOD HAZARD INFORMATION REPORT, BARTON CREEK, AUSTIN, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Available from City of Austin, and Texas Water Development Board, Austin, Texas. US Army Corps of Engineers Special Flood Hazard Informa-ion Report, Sept 1969. 6 p, 4 plate.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alter-natives, Maximum probable flood.
Identifiers: Barton Creek (Tex), Austin (Tex), Standard project flood, Intermediate regional flood.

Flooding of Barton Creek, Austin, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, and profiles indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages. (Knapp-USGS)
W70-07374

SPENCER V O'BRIEN (RIGHT OF RIPARIAN OWNERS TO BUILD DIVERSION WALLS).

158 SW2d 445-447 (Tenn Ct App 1941).

Descriptors: *Tennessee, *Diversion, *Diversion structures, *Riparian rights, Legal aspects, Streams, Bodies of water, Judicial decisions, Riparian land, Land tenure, Land use, Riparian waters, Flow, Overflow, Streamflow, Streambeds, Damages, Land reclamation, Watercourses (Legal), Barriers, Relative rights, Walls, Remedies.

Plaintiff and defendant were riparian owners on opposite bank of the same stream. Plaintiff sought to reclaim land along the stream by constructing a wall in the bed of the stream, thus preventing water from overflowing her property. Defendant attempted to protect her property by constructing a similar wall on the opposite bank of the stream. Plaintiff sought to enjoin defendant from further construction of her wall and to require her to tear out the existing wall in order to permit the waters to take their natural course on that side of the stream. Defendant filed a cross bill asking the court to require plaintiff to tear down plaintiff's wall and a cabin constructed where the streamwater would naturally flow. The chancellor held that neither party had committed a wrong, that each had a right to build such a wall, that each wall prevented overflow on their respective properties, and that neither wall operated to damage the other wall or the other party's property. The bill was dismissed and the Tennessee court of appeals affirmed. Riparian owners may not divert water upon property of other riparian owners to their damage. However, no damage occurred here and the walls served only to improve each owner's property. (Duss-Florida)
W70-07382

BOARD V SCHNEIDER (RELATIVE RIGHTS OF UPPER AND LOWER OWNERS TO OBSTRUCT AND DIVERT SURFACE RUNOFF).
191 SW2d 418-420 (Ky 1946).

Descriptors: *Kentucky, *Repulsion (Legal aspects), *Riddance (Legal aspects), *Surface runoff, Surface waters, Surface drainage, Obstruction to flow, Judicial decisions, Legal aspects, Natural flow, Flow, Overflow, Structures, Dams, Easements, Drains, Land, Land tenure, Diversion, Watercourses (Legal), Embankments, Barriers, Relative rights, Civil law.
Identifiers: *Servitudes.

Plaintiff was owner of an upper estate bounding defendants' lower estate. Surface water drained off along the boundary of the two estates flowing toward defendants' property. Plaintiff had placed debris on his land which interfered with the natural channel of drainage. Defendants then placed an obstruction along the boundary which backed up surface water onto plaintiff's land. Plaintiff brought suit against defendants and also the owner of the land above the two estates seeking damages and a mandatory injunction requiring defendants to remove their obstruction. The trial court dismissed the suit as to the other defendant and after hearing the evidence denied relief against the owners of the lower estate. The Kentucky court of appeals reversed, holding that the lower estate is subject to the servitude of receiving the natural flow of surface water from the upper estate. Defendants obstructed that flow. However, the owner of upper land does not have the right to divert the channel so that excess water flows on the lower land. Plaintiff apparently did this. Defendants should be required to remove their obstruction after plaintiff shall have restored his land to its previous condition. (Duss-Florida)
W70-07421

THOMAS V CITY OF CEDAR FALLS (ABATEMENT OF FLOODING CAUSED BY HIGHWAY EMBANKMENT BARRED BY LACHES).

272 NW 79-84 (Iowa 1937).

Descriptors: *Iowa, *Water level fluctuations, *Embankments, *Remedies, Judicial decision, Overflow, Water levels, Backwater, Fluctuation, Legal aspects, Water law, Local governments, Flow, Water control, Levees, Flood control, Governements, Highways, Structures, Obstruction to flow, Barriers, Damages.
Identifiers: *Nuisance abatement.

Plaintiff owned property a short distance from an offshoot of the Cedar River. An embankment supporting a highway was constructed in 1890 interrupting the course of the bayou adjacent to plaintiff's land. The embankment caused water in the bayou to flood plaintiff's land in time of high water. Plaintiff sough abatement of the nuisance caused by the embankment and requested that an opening be constructed sufficient to allow water to pass beneath the highway. Defendants claimed that any damages to plaintiff were permanent and arose at the time of construction of the embankment, thus barring plaintiff's claim on grounds of laches. The court held that where the obstruction to the free flow of water is caused by a permanent embankment and the injuries resulting are apparent at the time of construction, then the injuries are original, although not occurring immediately. The period of the statute of limitations begins at the time of construction. Plaintiff failed for 60 years to protest construction and maintenance of the embankment and was barred by laches from seeking relief for any damages arising from the construction. (Dye-Florida)
W70-07425

FENNEMA V MENNINGA (OBSTRUCTION OF SURFACE WATER FLOW).

19 NW2d 689-692 (Iowa 1945).

Descriptors: *Iowa, *Obstruction to flow, *Repulsion (Legal aspects), *Surface waters, Streamflow, Dikes, Levees, Judicial decisions, Legal aspects, Alteration of flow, Barriers, Diversion, Relative rights, Riparian rights, Flow, Flow control, Flooding, Flood damage, Easements, Water conveyance, Surface runoff, Civil law, Prescriptive rights, Remedies.

In 1913, a dike obstructing the flow of surface water from the upper land of plaintiff's grantor was erected on the lower land of defendant's predecessors. Plaintiff acquired the upper land in 1917 whereas defendant purchased the lower land in 1938. For 22 years neither plaintiff nor his predecessor in title complained about the maintenance of the dike or the frequent flooding of the upper land. However, plaintiff eventually brought an action to restrain defendant from maintaining the dike. The Iowa Supreme Court, affirming a judgment for defendant, held that the defendant had the right to assume that the adjacent landowners had acquiesced in the establishment of the dike. Plaintiff was estopped from enjoining defendant. The court reasoned that although a servient tenant cannot dam surface water and alter the natural flow thereof, the dominant tenant may by consent, express or implied, estop himself from objecting to interference with the flow of surface water. Furthermore, the dominant owner may so abandon his rights as to create a counter easement to have the water turned back upon the dominant estate. (Powell-Florida)
W70-07444

HOOSAC TUNNEL AND W RY V NEW ENGLAND POWER CO (FLOOD DAMAGE TO RAILROAD EMBANKMENT; DAM OWNERS LIABILITY FOR OPENING OF SLUICE GATES IN TIME OF EXTRAORDINARY RAINS).
42 NE2d 832-836 (Mass 1942).

Descriptors: *Massachusetts, *Dams, *Excessive precipitation, *Flooding, Floods, Washouts, Hurricanes, Judicial decisions, Legal aspects, Damages, Floodwater, Banks, Embankments, Powerplants, Maintenance, Sluices, Sluice gates, Railroads, Rivers, Streams, Flow, Overflow, Rain, Rainfall, Bridges.
Identifiers: *Negligence.

Plaintiff railroad brought suit against defendant owner of a dam and power plant for damages done to its roadbed and tracks. Plaintiff alleged negligence on the part of defendant in keeping sluice gates open during intensive flooding, thereby causing currents to wash away portions of the plaintiff's railroad embankment. The defendant answered by alleging extraordinary conditions due to intensive rainfall caused by a hurricane. The trial court directed a verdict for defendant and the Massachusetts supreme court affirmed. The flood conditions at the time of the damages constituted an act of God, and, while the defendant still had the duty to exercise reasonable care, the burden was on the plaintiff to prove defendant's negligence. The plaintiff's evidence indicated actions which might have been negligent under normal conditions, but the defendant was faced with utterly abnormal conditions. The defendant in his actions properly considered the possible effects to owners above the dam as well as those below. (Duss-Florida)
W70-07450

CITY OF ST CLOUD V PAPPENFUS (CONDEMNATION OF LAND TO BUILD HOLDING POND).

176 NW2d 85-87 (Minn 1970).

Descriptors: *Minnesota, *Local governments, *Condemnation, *Ponds, Legislation, State governments, Legal aspects, Ponding, Public rights, Eminent domain, Judicial decisions, Jurisdiction, Project planning, Drainage systems, Drainage programs, Storm runoff, Storm drains, Cities.

To improve the municipal storm drainage system the defendant city condemned land owned by the plaintiff as a site for the construction of a holding pond. The pond was to collect and hold excess storm waters before releasing them through the city's storm sewers into a nearbv river. Plaintiff contended that the city had no authority to condemn and should not be permitted to pursue drainage improvements without a plan to coordinate drainage over the total watershed area. Plaintiff also contended that the condemnation was wasteful and capricious. The court found that the taking of plaintiff's land was necessary and for a proper purpose and in accord with the controlling state statute. The court also found that the city had conferred with other agencies and governmental subdivisions, and the fact that no coordinated plan was developed could not prevent the city from taking action to solve its drainage problem. It was the proper function of the city to dispose of storm water in the most effective and economical mode available. (Hubener-Fla)
W70-07465

COMMONWEALTH V MARSHALL (DRAINAGE SYSTEM ON FARM DAMAGED BY CONSTRUCTION OF HIGHWAY).
452 SW2d 404-406 (Ky 1970).

Descriptors: *Kentucky, *Highway construction, *Drainage systems, *Tile drains, Condemnation, Eminent domain, State governments, Subsurface drainage, Drainage water, Surface waters, Culverts, Ditches, Flood damage, Administration, Legal aspects, Judicial decisions, Land tenure, Compensation, Damages, Flooding.

Defendant state condemned a portion of plaintiff's farmland as a site for the construction of a highway. Plaintiff claimed that the construction virtually destroyed a tile drainage system located on a remaining portion of the land. As a result flooding occurred on plaintiff's bottom land previously drained by the tile system. Plaintiff further alleged that the damage to their land was permanent since flooding would recur. Defendants contended that photographs showing a highway culvert clogged with debris were taken during the construction period and did not fairly indicate the maintenance which would be give to highway ditches and culverts draining plaintiff's land after completion of the ihighway. In affirming the trial court's judgment for plaintiff, the court ruled that the question of whether damage to the land by impairment of the drainage system was permanent or temporary was a question for the jury, and the photographs were admissible to aid in such a determination.9see also W69-00338) (Hubener-Florida)
W70-07493

NEW ENGLAND MICA CO V WALTHAM FACTORIES (FLOODING CAUSED BY FLASHBOARDS ABOVE THE DAM).
16 NE2d 81-85 (Mass 1938).

Descriptors: *Massachusetts, *Dams, *Floods, *Flood damage, Judicial decisions, Damages, Barriers, Backwater, Design flood, Flow control, Maximum probable flood, Overflow, Retaining walls, Flood control, Flood forecasting, Floodgates, Control structures, Overland flow, River flow, Streamflow, Water injury, Levees, Floodwater.
Identifiers: Flashboards, Negligence.

Defendant operated a dam downstream from plaintiff's factory and had acquired the right to maintain flashboards 20 inches above the dam and to flood the surrounding land to that extent. From time to time defendant increased the height of the flashboards to 36 inches, which had to be removed when high water endangered the surrounding property. On one such occasion the flashboards were removed just prior to a crest in the stream which overflowed into plaintiff's factory. Plaintiff sued for damages. The court found that defendant had not acquired a prescriptive right to maintain the flashboards above 20 inches, and that to remove them at such a late time was fruitless. It held that it was not the actual flowage but the efficient height of the dam in its ordinary operation which measured the limits of the dam's operation. Defendant was found to be negligent in its operation of the dam, and the negligence was held to be the proximate cause of plaintiff's damages. The case was remanded to consider the question of damages. (Douberley-Florida)
W70-07527

PEOPLE V WILLIS (PRIVATE DRAINAGE DITCHES AS NUISANCES).

173 Misc 442, 17 NYS2d 784-790 (Ct Spec Sess 1940).

Descriptors: *New York, *Condemnation, *Easements, *Ditches, Public health, Adjudication procedure, Boundaries (Property), Drainage, Judicial decisions, Legal aspects, Land tenure, Local governments, Proprietary power, Public rights, Relative rights, Condemnation value, Drainage systems, Mosquitoes.
Identifiers: *Nuisance.

Plaintiff city had years earlier obtained an easement to build a drainage ditch across land now held by defendant. That ditch outlived its usefulness and was filled in, but several years later another ditch was dug at right angles to the old one. The record did not disclose by whom it was constructed. Defendant was attempting to improve his property by filling in the second ditch, when he was stopped by plaintiff and ordered to reopen it. Defendant refused, and the city charged him with filling in a natural drainage system in violation of a city ordinance prohibiting private nuisances. The court held that the city had no authority to convert a private drain into a public one without first acquiring the property on which the drain was located. Moreover, the ordinance made the existence of a nuisance a factual question and a condition precedent to the establishment of guilt. To establish the nuisance, it is essential to show evidence of the injury in fact. No such evidence was indicated, and no duty rested on defendant to keep the ditch on his property unobstructed. (Clarke-Florida)
W70-07544

STROUGH V CONLEY (DIVERSION OF WATER FROM NATURAL CHANNEL).

251 App Div 487, 297 NYS 785-789 (1937).

Descriptors: *New York, *Diversion, *Channeling, *Easements, Reservoir, Alteration of flow, Routing, Water supply, Natural flow doctrine, Channel flow, Relative rights, Riparian rights, Cities, Judicial decisions, Condemnation, Legal aspects, Right-of-way, Eminent domain, Natural streams, Watercourses (Legal), Cities.

Fifty years before commencement of this action, plaintiff village had acquired the right to divert four small streams into a larger stream which flowed into the village reservoir. The village subsequently acquired a supply of water from another source and desired to discontinue its former supply from the creeks and to return those waters to their original channels. Defendants, lower riparian owners over whose property the creek water had naturally flowed objected since they had improved and cultivated the former natural channel. The court held that the village was estopped from returning the waters to their natural course of flow since a city had no right to turn drainage water on lands of another. The court also held that the village could not reconstruct drainage channels over lower lands nor could they condemn land for new channels over lands. The dissent stated that the city could exercise the easement originally given to divert the waters or could cease to divert the waters at its own will, and the lower riparian owners would have no cause of action. (Hubener-Florida)
W70-07553

MOREHEAD AND NORTH FORK RY V CRAWFORD (FLOODING CAUSED BY OBSTRUCTION OF CULVERT).
296 Ky 636, 178 SW2d 14-17 (1944).

Descriptors: *Kentucky, *Obstruction to flow, *Surface drainage, *Culverts, Surface waters, Legal aspects, Judicial decisions, Land, Land tenure, Railroads, Mining, Damages, Floods, Rain, Rainfall, Flow, Overflow, Drainage, Streams, Watercourses (Legal), Flooding, Excessive precipitation.

Plaintiff landowner brought suit against defendant railroad for damages to his residence caused by overflow from a couvert maintained by defendant. Plaintiff had contracted to permit a mining company to dump rock and dirt upon his land upstream from the culvert. At the same time defendant placed some ties on its right-of-way upstream from the culvert. These were a gift to plaintiff and placed there for his use. Heavy rainfall washed the rock, dirt and ties down to the culvert obstructing the flow through it and backing the water onto plaintiff's land. Plaintiff alleged negligence of the defendant in keeping the culvert open to handle the flow. He also alleged other acts of the defendant which increased the flow to the culvert. At trial the plaintiff received judgment, but the Kentucky court of appeals reversed on the grounds that a mere scintilla of evidence was not sufficient to submit the issues to the jury. Evidence tended to show that the culvert was adequate for ordinary flow. Plaintiff's damage occurred after heavy rainfall and, from the evidence, was not due to defendant's actions. Without more evidence defendant should have received a directed verdict. (Duss-Florida)
W70-07562

WHITE V HOWE (FLOODING OF UPPER ESTATE CAUSED BY INCREASE IN DITCH EMBANKMENT BY LOWER ESTATE).
293 Ky 108, 168 SW2d 28-30 (1942).

Descriptors: *Kentucky, *Surface runoff, *Embankments, *Repulsion (Legal aspects), Surface drainage, Surface waters, Legal aspects, Judicial decisions, Ditches, Banks, Levees, Dams, Natural flow, Elevation, Damages, Land, Land tenure, Floods, Over-flow, Construction, Maintenance, Repairing, Civil law, Riddance (Legal aspects), Remedies, Obstruction to flow.
Identifiers: *Servitudes.

Plaintiffs and defendants owned adjoining farms along the boundary of which a drainage ditch had been constructed by predecessors of the present owners to drain surface water into a public ditch. Plaintiffs' land was of higher elevation than that of defendants. Defendants undertook to repair breaks in their bank and to construct an embankment to raise its elevation. The increased elevation caused diversion of the surface water from its natural flow, backing it up and flooding plaintiffs' land. Plaintiffs objected and requested that defendants restore the former level of the bank. Defendants desisted from further construction but refused to remove the completed elevation. Plaintiffs brought suit seeking an injunction requiring defendants to restore the bank to its former level. The chancellor granted relief and defendants appealed, primarily on three grounds: (1) lack of specificity in the plaintiffs' petition as to the height of the former elevation; (2) that injunctive relief was too drastic a relief as there was no irreparable injury; and (3) plaintiffs were estopped from complaining of defendants' repair of the breaks in its bank. The Kentucky court of appeals affirmed the judgment holding that the owner of a lower estate is subject to the servitude of receiving the natural flow of water from the upper

estate. Plaintiffs objected to the embankment not defendant's repairs. Finally. plaintiffs' lack of specificity in their petition was non-prejudicial. (Duss-Florida)
W70-07563

STONE V ASHURST (DRAINAGE ACROSS ADJOINING PROPERTY).

285 Ky 687, 149 SW2d 4-6 (1941).

Descriptors: *Kentucky, *Natural flow doctrine, *Repulsion (Legal aspects), *Riddance (Legal aspects), Obstruction to flow, Adjudication procedure, Boundaries (Property), Judicial decisions, Legal aspects, Proprietary power, Relative rights, Diversion, Alteration of flow, Dams, Culverts, Drains, Surface drainage, Flooding, Highways, Ditches.

Plaintiff and defendant owned adjoining land separated by defendant's driveway. Plaintiff's land was the upper estate and in order to facilitate its drainage, which naturally flowed from plaintiff's land across defendant's plaintiff built a culvert underneath defendant's driveway with defendant's reluctant permission. A culvert under a highway adjacent to plaintiff's land drained onto plaintiff's land, and in order to facilitate the movement of the water, plaintiff dug several ditches which channeled the water through the culvert under defendant's driveway. Defendant then removed the culvert and raised his driveway, causing a large pool of water to back up onto plaintiff's land. Plaintiff sought to require the defendant to replace the culvert, and defendant cross-claimed to require plaintiff to fill the ditches. The court held that a lower estate is required to receive the natural flow of surface water from the upper estate, and the lower owner has no right to create obstructions which will cause the natural flow to stop and back up on the upper ground. At the same time, the upper owner has no right to make excavations on his land by which the flow of surface water is diverted from its natural course and channeled onto the lower estate in unnatural volume. Plaintiff was required to fill the ditches, and defendant was required to replace the culvert. (Bud Clarke-Florida)
W70-07564

COLLINS V PIGMAN (INJUNCTIVE RELIEF AGAINST RIVER DIVERSION CREATED BY LANDFILL).
292 Ky 240, 165 SW2d 955-957 (1942).

Descriptors: *Kentucky, *Landfills, *Diversion, *River flow, Obstruction to flow, Currents (Water), Legal aspects, Judicial decisions, Rivers, Banks, Flow, Channel flow, Riparian rights, Abatement, Land tenure, Construction, Structures, Erosion, Washouts, Bridges, Natural flow, Watercourses (Legal), Flooding, Remedies, Damages.

Plaintiffs owned a lot and house on the riverfront opposite defendant's land. Defendant permitted the city to take rock and stone from his property to construct a bridge nearby. He also directed his employees to construct a fill along the bank of the river. This fill caused a change in the current of the river from defendant's side to plaintiffs' side and caused damage to plaintiffs' land. Plaintiffs brought suit against defendant landowner, the city constructing the bridge, and the foreman in charge of the bridge construction, seeking to enjoin further extension of the fill and to require removal of that part completed. Plaintiffs also sought damages. The chancellor dismissed the suits as to the other defendants but granted injunctive relief as to the defendant landowner. Defendant appealed on several grounds including: (1) that plaintiffs failed to show the fill changed the current or channel of the river; and (2) that they were estopped because they had waited until completion of the fill to bring suit. The Kentucky court of appeals affirmed the chancellor's decision. Evidence supported a finding that the fill diverted the current upon plaintiffs' land. The court also held that it is the general rule that one may not stand by and permit another to construct a nusiance and then seek equitable relief from the courts. However, this does not apply where the resulting damage is not apparent before completion of the structure. Such was the case here. (Duss-Florida)
W70-07569

NORFOLK AND W RY V MCCOY (DAMAGES CAUSED BY DIVERSION AND OVERFLOW; PERMANENT OR TEMPORARY).
288 Ky 458, 156 SW2d 493-497 (1941).

Descriptors: *Kentucky, *Diversion, *Landfills, *Damages, Overflow, Floods, Erosion, Washouts, Railroads, Land tenure, Land, Rivers, River flow, Judicial decisions, Legal aspects, Tidal waters, Abatement, Watercourses (Legal), Real property, Remedies, Construction, Market value.

Plaintiffs, intestate successors to deceased owner of land, brought suit to recover for damages to the land due to flooding caused by defendant railroad's construction of a fill on its property. The construction diverted the natural flow of a river onto plaintiffs' land causing the land to wash and erode. The deceased owner had brought suit to recover damages on four previous occasions, each time receiving judgment. Each time, the Kentucky court of appeals had reversed because the verdicts were excessive. In the plaintiffs' action the court again reversed, finding that there was an erroneous instruction to the jury and, again, an excessive verdict. In all the actions to recover damages, the character of the railroad fill was described as permanent. The court held that the proper measure of damages in such cases is the difference between the fair market value of the damaged land before construction and afterwards. In the trial court's instruction it was left open to the jury to determine damages based on a temporary structure. This permitted the jury to consider separate incidents of damage caused by the fill. This was prejudicial to defendant. (Duss-Florida)
W70-07584

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (TERMS OF THE STATUTE AND THE HYDROLOGIC CYCLE),
For primary bibliographic entry see Field 06E.
W70-07586

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (PRE STATUTORY SURFACE WATER RIGHTS),
For primary bibliographic entry see Field 06E.
W70-07587

SCHULTZ V PIKESH (OBSTRUCTION OF SURFACE RUNOFF).
380 Ill 75, 43 NE2d 552-554 (1942).

Descriptors: *Illinois, *Drainage, *Surface runoff, *Repulsion (Legal aspects), Judicial decisions, Surface waters, Surface drainage, Flow, Drainage water, Legal aspects, Water law, Highways, Roads, Roadbanks, Structures, Obstruction to flow, Barriers, Diversion, Relative rights, Erosion, Walls, Remedies, Erosion control.

A road separated defendant's land from plaintiff's. Drainage from the road caused flooding on the property of defendant and plaintiff. Plaintiff's land was the lowest of the two pieces of property. Plaintiff constructed an obstruction to prevent drainage from the road onto her property. Defendant constructed a corresponding obstruction to prevent drainage onto her property. Plaintiff protested that defendant's obstruction, a low concrete wall no higher than the level of her property prior to erosion, caused water to drain onto plaintiff's property. The lower court dismissed the complaint for lack of equity, and the Supreme Court of Illinois affirmed, stating that plaintiff put herself in a poor position to ask for equity by building the original obstruction. Defendant's obstruction was no greater than plaintiff's and was of no greater height than the property prior to the erosion caused by plaintiff's obstruction. (Dye-Florida)
W70-07599

FORTIER V H P HOOD AND SONS, INC (ACTION TO ENJOIN THE CASTING OF WATERS ONTO PLAINTIFF'S LANDS).
30 NE2d 253-258 (Mass 1940).

Descriptors: *Massachusetts, *Drains, *Reasonable use, *Drainage, Streams, Drainage practices, Judicial decisions, Legal aspects, Watersheds (Basins), Canals, Ditches, Pipes, Sewers, Industrial water, Easements, Drainage water, Dairy industry, Damages, Water pollution, Prescriptive rights, Cities, Relative rights.

Plaintiff brought a bill to enjoin defendant dairy from causing water to flow upon its lands. The court-appointed master found that defendant utilized certain ditches, pipes and drains across plaintiff's lands causing water in an appreciable quantity to be thrown upon them in an artificial stream. The court found that throwing an artificial stream upon the land of another, in the absence of any easement or other right, constitutes a continuing trespass for which an injunction should lie. Defendant was not relieved of responsibility for its acts by the fact that other persons and sources contributed to the flow of the same stream into which it placed its waters. Although the defense of implied easement was rejected, the court did find that the use of the drains, pipes and ditches across plaintiff's lands since 1917 did create a prescriptive easement for defendant to place upon plaintiff's land a quantity of water equal to the amount placed there in 1917 when the easement began. (Barnett-Florida)
W70-07603

FERGUSON V VILLAGE OF HAMBURG (ACTION TO ENJOIN CITY FROM DIVERTING WATERS FROM A STREAM)
5 NE2d 801-803 (NY 1936).

Descriptors: *New York, *Cities, *Diversion, *Riparian rights, Dams, Administrative agencies, Administration, Judicial decisions, Legal aspects, Streams, Structures, Obstruction to flow, Prior appropriation, Remedies, Eminent domain, Condemnation, Lakes, Reservoirs, Sewage, Outlets, Damages, Legislation, Remedies.

Plaintiff brought suit to enjoin defendant city from taking and diverting waters from a stream which crossed plaintiff's land. Plaintiff also asked for removal of a dam erected by defendant which obstructed the natural flow of water across her land. The lower court granted the injunction and required defendant to acquire the right to appropriate the waters either by grant or condemnation proceedings. The appellate court found that plaintiff was not entitled to an absolute injunction although defendant had impaired her riparian rights. The court held that inverse condemnation was the proper method of relief. Plaintiff was entitled to the amount of the past and permanent damages resulting from the impairment of her riparian rights and also to an injunction should the defendant fail to pay the damages. This would adequately reimburse plaintiff for the impairment of her riparian rights and permit defendant to continue to furnish its inhabitants with water. (Barnett-Florida)
W70-07605

EDASON V DENISON (INCREASED FLOW OVER LOWER LAND CAUSED BY DITCH IMPROVEMENT ON UPPER LAND).
194 So 342-343 (Fla 1940).

Descriptors: *Florida, *Surface drainage, *Repulsion (Legal aspects), *Riddance (Legal aspects),

Surface runoff, Drainage systems, Drainage effects, Overflow, Surface waters, Runoff, Overland flow, Ditches, Routing, Flow control, Water conveyance, Natural flow, Artificial watercourses, Channels, Natural streams, Banks, Channel improvement, Legal aspects, Judicial decisions, Relative rights, Dams.

Plaintiff and defendants were adjoining landowners. A drainage ditch originated on land of one defendant and crossed the lands of second defendant and plaintiff. Defendants deepened and widened the ditch, thereby increasing the flow across plaintiff's land and causing damage to his truck crop. Plaintiff sought to restrain enlargement of the ditch and also to restrain defendants from entering his land and destroying dams constructed to hold water off his property. The trial court enjoined defendants from destroying the dams but dismissed the bill seeking to enjoin enlargement of the ditch on defendants' lands. The supreme court affirmed the dismissal stating that an upper riparian owner may, to prevent overflow onto upper lands, improve, deepen and widen artificial channels along a natural watercourse, even though the result is to increase the volume and speed of the stream-flow over an abutting owner's land. The lower riparian owner is charged with the burden of protecting his land from the increased volume of flow, but has no cause of action against the upper proprietor. (Hubener-Florida)
W70-07609

FULLER V STATE (FLOODING; SURFACE WATER; UNPRECEDENTED RAINFALL; DRAINAGE SYSTEMS).
46 NYS2d 762-766 (Ct Cl 1944).

Descriptors: *New York, *Flood control, *Drainage systems, *Excessive precipitation, Drainage, Judicial decisions, Legal aspects, Natural flow doctrine, Proprietary power, Public rights, State governments, Floods, Overflow, Rainfall, Storm drains, Surface waters, Surface runoff, Rainfall intensity, Flooding, Surface waters.

Plaintiff's house and his personal belongings which were stored in his basement were damaged when an extradinary flood of surface water washed out a wall of the dwelling. With the construction of a housing subdivision the area surrounding plaintiff's house had changed from basically rural to residential. This construction added many new streets which intersected with the one on which plaintiff's house was located. Plaintiff contended that in view of the increased surface runoff caused by the intersection of the new streets, defendant state had been negligent in failing to provide ditches and culverts adequate to properly drain during heavy rains the street on which he lived. Moreover, it was contended, the lack of adequate drainage caused the flooding damage to his house. The court found from the evidence that the rainfall which caused the flooding was unprecedented, and that defendant had reconstructed the drainage facilities according to accepted standards applicable to the terrain. Defendant's failure to anticipate the extraordinary rainfall was not actionable negligence. In any case, damage caused by surface waters augmented by unprecedented rainfall will give no recovery. (Clarke-Florida)
W70-07613

PFEIL V TRISCHETT (IMPROVEMENTS TO LAND AND STREAMBED CHALLENGED BY LOWER RIPARIAN OWNER).
137 NYS2d 668-669 (1954).

Descriptors: *New York, *Riparian rights, *Relative rights, *Grading, Obstruction to flow, Developed waters, Watercourses (Legal), Natural flow, Levees, Natural flow doctrine, Judicial decisions, Natural watercourses, Ditches, Streams, Surface runoff, Land use, Proprietary power, Channels, Diversion, Riddance (Legal aspects), Repulsion (Legal aspects).

Plaintiff and defendants were adjoining riparian landowners, plaintiff holding land located downstream from defendants. Plaintiff brought a complaint alleging that the defendants had artificially channelled and changed the course of the stream with the result that water from defendants' property had been cast upon the land of the plaintiff. The court noted that the plaintiff did not allege that the defendants caused the stream to overflow its banks or divert the stream from the point where it originally entered plaintiff's property. The complaint did allege, however, that the defendants had increased the elevation of their land and thus increased the flow of water onto plaintiff's land. The court held the complaint insufficient, stating that the owner of lands drained by a watercourse exercises a legal right in using his land to change or control the flow of surface water therein in a reasonable manner. The reasonable grading of one's lands in making improvements thereon creates no liability for water cast upon another's land. (Hubener-Florida)
W70-07616

DRAINAGE--SANITARY DISTRICTS (STRUCTURE, FORMATION AND ADMINISTRATION).
111 Ann Stat ch 42, secs 247, 259, 260, 261, 266, 267, 270, 283, 284, 289, 291, 292, 294, 295, 296 (Smith-Hurd 1956), as amended, (Supp 1969); secs 296.1, 296.4 (1969).

Descriptors: *Illinois, *Waste disposal, *Drainage districts, *Administrative agencies, Administration, Water supply, Wastes, Legislation, Flood control, Channel improvement, Water management (Applied), Water policy, Levees, Drainage, Water pollution control, Drainage systems, Condemnation, Easements, Cost repayment, Right-of-way, Eminent domain, Legal aspects, Sewage districts, Financing, Taxes.

Areas of 2 counties or more, situated so as to be subject to overflow from any river, may be incorporated as sanitary districts with the purpose of constructing and operating facilities to improve drainage and facilitate waste disposal. Such districts shall have boards of trustees empowered to levy taxes to build levees and works, and may exercise the powers of eminent domain to obtain property necessary for performance of district functions. Limitations are placed upon the taking or use of rights on railroad, highway, street, wharf, levee or similar property. The boards of trustees may compel railroad companies to elevate their tracks. Borrowing of money, extension of facilities outside each district, condemnation and letting of contracts are regulated by statute. Acquisition of rights-of-way over public property and contracts with outside territory for use of district channels and drains are within the purview of the trustees. Sanitary districts shall have police power to regulate pollution in water supplies. Costs shall be defrayed by general and special taxation applied to property within each district and by issuance of bonds. (See also W70-07619 thru W70-07622). (Dye-Florida)
W70-07618

DRAINAGE-SANITARY DISTRICTS (FORMATION; POWERS OF TRUSTEES).
111 Ann Stat ch 42, secs 247, 159, 260 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Sewage districts, *Waste disposal, *Drainage districts, Administration, Water supply, Environmental sanitation, Wastes, Waste water disposal, Local governments, Legislation, Flood control, Channel improvement, Drainage systems, Levees, Water management (Applied), Water policy, Water law, Governments, Drainage, Legal aspects, Administrative agencies.

When any contiguous territory (1) within the limits of 2 counties; (2) containing 2 or more incorporated cities, and (3) with a population greater than 3500, is subject to overflow from any river, and the maintenance of levees or implementation of improved drainage would promote the public health or safety, the area may be incorporated as a sanitary district in the manner set forth by statute. No territory may be included in more than one sanitary district. The trustees of the district may construct and maintain such levees, drains, treatment plants, pumping plants, and outlets as may be necessary for protection from overflow and disposal of wastes. The trustees may extend such works into cities within the district for connection with municipal waste disposal facilities. The district may contract for reasonable compensation with a city for disposal of the city's wastes through district facilities. District facilities may extend beyond the limits of the district, but no taxes may be levied by the district on extra-district property. The district is liable for damage caused by its activities outside the district. (See also W70-07618). (Dye-Florida)
W70-07619

DRAINAGE--SANITARY DISTRICTS (ACQUISITION OF PROPERTY AND DRAINAGE DISTRICTS).
111 Ann Stat ch 42, secs 261, 266, 267, 270 (Smith-Hurd 1956).

Descriptors: *Illinois, *Drainage districts, *Sewage districts, *Administrative agencies, Administration, Water supply, Waste disposal, Environmental sanitation, Wastes, Waste water disposal, Local governments, Governments, Legislation, Flood control, Drainage systems, Levees, Water management (Applied), Water policy, Drainage, Condemnation, Easements, Cost repayment, Right-of-way, Eminent domain, Legal aspects.

Sanitary districts may acquire by purchase, condemnation, or otherwise property required for their corporate purpose. All moneys for such acquisition must be paid before possession is taken. When it is necessary for a district to acquire or use any portion of a railroad right-of-way, street, highway, wharf, levee, or other property of public interest, only such easement of rights necessary for the purposes of the district shall be taken. So far as praticable the use of such property shall be reserved to the public, company, or other persons entitled thereto. When necessary, the district may require any railroad company to elevate its tracks to conform to the grade of any district facility. The district may require railroads to maintain culverts, ditches, drains, or sewers for elimination of standing water on railroad rights-of-way. If any sanitary district includes within its limits any drainage district conducive to sanitary purposes, the sanitary district may appropriate such facilities on payment of the reasonable cost or value of such facilities--in no case fixed at an amount less than any unpaid indebtedness incurred by the drainage district in contracting the facilities. (See also W70-07618). (Dye-Florida)
W70-07620

DRAINAGE - SANITARY DISTRICTS (WASTE DISPOSAL; ACQUISITION AND USE OF PUBLIC PROPERTIES; CONDEMNATION; SEWAGE TREATMENT).
For primary bibliographic entry see Field 05G.
W70-07621

DRAINAGE-SANITARY DISTRICTS (COOPERATION OF DISTRICTS; POLICE POWER; COSTS).
111 Ann Stat, ch 42, secs 294, 295, 296 (Smith-Hurd 1956), as amended, (Supp 1969); secs 296.1, 296.4 (1969).

Descriptors: *Illinois, *Drainage districts, *Cost allocation, *Water supply, Administration, Sewage districts, Local governments, Governments, Legislation, Waste disposal, Water management (Applied), Water policy, Drainage, Water pollution, Water pollution control, Environmental sanitation, Administrative agencies, Coordination, Construction costs, maintenance costs, Facilities, Cities, Legal aspects, Taxes, Assessments.

Any sanitary district may allow water from other territories, on terms mutually agreed upon, to drain into district drains. Sanitary districts may organize water districts so as to provide, through use of water supplies of towns possessing such means, pure water for towns possessing no means of procuring water. A district may exercise police power to prevent pollution of water supplies of cities within the district. When operating within any city district, police officers shall act subject to the direction of minicipal authorities. Sanitary districts may defray the cost of construction, maintenance, and operation of district facilities by general taxation or special assessments. No property may be assessed for more that it is benefited by the improvement for which the assessment is levied. (See also W70-07618). (Dye-Florida)
W70-07622

LEADER V MATTHEWS (ACTION TO COMPEL REMOVAL OF DAM TO PREVENT INJURIOUS IMPOUNDMENT OF WATERS).
95 SW2d 1138-1141 (Ark 1936).

Descriptors: *Arkansas, *Watercourses (Legal), *Surface waters, *Repulsion (Legal aspects), Competing uses, Judicial decisions, Ephemeral streams, Dams, Reservoirs, Reasonable use, Impoundments, Backwater, Discharge (Water), Flood routing, Impounded waters, Runoff, Riddance (Legal aspects), Legal aspects, Structures, Relative rights, Land tenure, Surface runoff, Boundaries (Property).

Plaintiff sought a mandatory injunction requiring defendants to remove a dam erected along the dividing line between their properties. It was alleged that the dam obstructed a watercourse, thereby impounding waters and causing them to overflow plaintiff's land. The questions involved were whether the waters were to be considered a watercourse, and if not, could defendant properly fend the waters from his property for his own protection. Evidence adduced at trial showed that the water travelled, not in a defined watercourse, but more toward a depression or reservoir on defendant's land. The court held that floodwaters flowing into low places and filling them to overflowing do not necessarily constitute watercourses. The defendant landowner was justified in defending against such flood waters and could do so without incurring liability, unless he unnecessarily injured or damaged another. The waters in this case were overflow waters and against these the landowner had the right to defend himself, as against a common enemy, without rendering himself liable for damages. (Barnett-Florida)
W70-07629

MCCORD V BIG BROTHERS MOVEMENT, INC (DIVERSION FOR GUESTS' RECREATION).
185 A 480-482 (NJ 1936).

Descriptors: *New Jersey, *Recreation facilities, *Reasonable use, *Withdrawal, Judicial decisions, Riparian rights, Mills, Engineering structures, Mill dams, Ponds, Standing waters, Fresh water, Water holes, Streamflow, Low flow, Natural flow, Alteration of flow, Diversion, Downstream, Routing, Swimming, Stagnant water, Domestic water, Riparian owner, Legal aspects.

Plaintiffs utilized water from a stream running through their land to operate a grist mill. Water was diverted from the stream by a number of dams and returned to the stream below the grist mill. Upstream from plaintiff's mill defendant pumped water from the stream into a swimming pond to prevent it from becoming stagnant during the summer months. Plaintiffs sought restraint against further use of the pump and complained that these extractions by defendant materially increased the difficulty of mill operation during the dry summer months. The court held that a riparian owner is entitled to the reasonable use of stream waters for domestic and irrigation purposes, and that a lower owner is entitled to the natural flow undiminished by unreasonable use. Riparian rights may be claimed by the owner only, and a diversion for the use of invitees of the owner was held to exceed the reasonable use to which defendant was entitled. Since the withdrawals reduced the power of the mill by one-sixth horsepower, the court found the loss to plaintiffs to be material and the restraint justified. (Douberly-Florida)
W70-07630

KASUBA V GRAVES (LIABILITY FOR DAMAGE CAUSED BY PUMPING WATER INTO STREAM).
194 A 455-462 (Vt 1937).

Descriptors: *Vermont, *Reasonable use, *Flow augmentation, *Overflow, Judicial decisions, Riparian rights, Riparian land, Natural flow doctrine, Alteration of flow, Relative rights, Remedies, Usufructuary right, Water level fluctuations, Water levels, Overland flow, Streamflow, Discharge (Water), Flooding, Sediment transport, Culverts, Quarries, Damages, Relative rights, Legal aspects.

To drain several pits defendant quarry operator pumped water into a brook which ran throught plaintiff's farm. This pumping caused the water level to rise above a culvert placed by plaintiff between his house and barn, to overflow onto plaintiff's farm land and damage the crops, and to cut new channels through plaintiff's fields. Plaintiff sought injunctive relief and damages, but no evidence of damages was brought forward. The court held that defendant had a right to reasonable use of the stream so long as it did not cause substantial harm to plaintiff. Considering the size and character of the brook, the court found defendant's use to be unreasonable. The trial court had allowed defendant to pump as much water into the brook as was necessary for the operation of the quarry, but the appellate court held that the necessities of defendant could not measure the rights of plaintiff. Plaintiff was under no obligation to keep the culvert open to accommodate the increased volume of water. Defendant was found to have no right to discharge water so as to injure plaintiff in this manner. (Douberley-Florida)
W70-07633

ZAMELLI V TROST (LIABILITY FOR DAMAGE CAUSED BY DRAINAGE DITCH OVERFLOW).
132 NJL 388, 40 A2d 783-784 (NJ 1945).

Descriptors: *New Jersey, *Ditches, *Surface runoff, *Overflow, Judicial decisions, Dams, Canals, Drainage, Gullies, Open channels, Trenches, Water conveyance, Surface waters, Excess water (Soils), Repulsion (Legal aspects), Riddance (Legal aspects), Real property, Flow, Natural flow, Retention, Diversion, Overland flow, Runoff, Legal aspects.
Identifiers: Water damage.

Defendant's land was slightly elevated above and adjacent to plaintiff's land. Defendant dug a ditch on his own land and dammed up one end, causing the water which accumulated in it to flow onto plaintiff's property. Plaintiff sued for damages caused by the water. The court found for defendant, holding that no right can be claimed for the mere flow of surface water, and that neither its retention, diversion, repulsion or altered transmission is an actionable injury. (Douberley-Florida)
W70-07635

NOE V BENGEY (BUILDING OF WALL ALONG BANK IN RIVERBEND HALTED BY RIPARIAN OWNER ON OPPOSITE SIDE OF RIVER).

125 SW2d 721-722 (Ky 1939).

Descriptors: *Kentucky, *Structures, *Bank protection, *Walls, Riparian rights, Diversion structures, Currents (Water), Streamflow, Bank erosion, Avulsion, Bank stability, Channel erosion, Bank stabilization, Channel morphology, Embankments, River beds, Judicial decisions, Water law.
Identifiers: Accretion (Legal aspects), Legal aspects, Remedies, Flow augmentation.

Plaintiff and defendant were riparian owners on opposite sides of a river bend. Defendant began construction of a wall to extend approximately 600 feet along the river bank at the bend. Plaintiff sought an injunction to halt construction alleging that the wall would narrow the channel and divert the flow of the current so as to wash out the river bank on his side. Defendant contended that the structure was intended to prevent his own banks from washing out and that the wall would not change the course of the streamflow. The court granted the plaintiff an injunction stating that such a narrowing of the stream as would occur would throw currents against the opposite bank with much greater than normal force causing irreparable damage to the land on plaintiff's side. (Hubener-Florida)
W70-07637

HALSTEAD V YOUNG (RIGHT TO OVERFLOW LAND ADJACENT TO DAM).

276 NW 703-706 (Mich. 1937).

Descriptors: *Michigan, *Flooding, *Milldams, *Overflow, Judicial decisions, Real property, Dams, Water law, Legal aspects, Land, Land use, Submergence, Mills, Land tenure, Structures, Facilities, Streamflow, Flow, Prescriptive rights, Easements.

To the extent afforded by maintenance of an 8-foot head of water at a dam on defendant's property, defendant's ancestor in title acquired from plaintiff's ancestors in title the right to flow plaintiff's land. Defendants lowered the level of the tailrace one foot, thus increasing the head to 9 feet, but flowing no additional property. The court held that the area to be flowed is to be determined according to conditions at the time of the grant, and the lowering of the tailrace did not require lowering of the head since no additional property was flooded. The lands of one plaintiff were not included in the original grant and defendant's right to flow them depended upon acquisition of such rights by prescription. The prescriptive period for establishment of a right of flowage was 15 years, and the weight of conflicting testimony was sufficient to warrant a finding that defendants have established a prescriptive right to flow the land. (Dye-Florida)
W70-07639

MCFAUL V EAU CLAIRE COUNTY (LEASE; EASEMENT TO FLOOD; ADVERSE POSSESSION).
292 NW 6-9 (Wis 1940).

Descriptors: *Wisconsin, *Flooding, *Prescriptive rights, *Leases, Judicial decisions, Overflow, Land tenure, Real property, Dams, Water law, Legal aspects, Legislation, Land, Land use, Submergence, Easements, Local governments, Taxes, Rent, Relative rights, Public lands.

Plaintiff's grantor conveyed property to defendant county, taking back a 99-year lease and reserving in defendant the right to flood the property at any time. Rental payments consisted of payment of taxes on the property. Grantor then conveyed to plaintiff by warranty deed, plaintiff having no knowledge of the previous conveyance until four years after purchasing the property. Plaintiff never notified defendant of any intention to claim any rights in opposition to the lease. Defendant proposed to overflow the property. Plaintiff claimed title to the property by adverse possession. The court held that, since the lease was recorded, plaintiff had constructive notice of the lease and defendant's rights thereunder. Plaintiff had actual notice within four years of purchase. Plaintiff's possession was consistent with the lease and gave defendant no notice of hostile possession. There was no default in rental payments to give notice to de-

fendant. There was no adverse possession effective to establish title and defendant's right to flood the property was unchanged. (Dye-Florida)
W70-07640

THOMSON V PUBLIC SERVICE COMM'N ('-FLOOD WATERS' HELD NOT TO INCLUDE POND OVERFLOW).
5 NW2d 769-772 (Wis 1942).

Descriptors: *Wisconsin, *Surface waters, *Obstruction to flow, *Floodwater, Barriers, Ponds, Drainage, Marshes, Standing waters, Flooding, Embankments, Roadbanks, Highways, Legislation, Legal aspects, Judicial decisions, Flow, Natural flow, Railroads, Culverts, Structures, Drains, Roads, Surface drainage.

Plaintiff railroad maintained tracks upon an embankment adjacent to a surface water pond. The pond had no inlet or outlet and was filled by water draining from surrounding terrain. In times of high water the pond extended to plaintiff's embankment. Defendant Public Service Commission claimed that plaintiff's embankment obstructed the depression over which surface water would naturally flow and caused flooding to occur on adjacent property. The Public Service Commission ordered plaintiff to construct culverts to allow surface water to drain beneath plaintiff's tracks and the plaintiff sought to set aside the order. The statute under which the Public Service Commission sought to obtain construction of culverts required railroad companies to maintain culverts to protect adjacent property from damage caused by flood waters. The court held that flood waters are those which break away from the normal course of a stream under unusual conditions. The waters involved in the instant case were not flood water, but surface waters not forming part of a watercourse. The statute was inapplicable and the order of the Commission set aside. (Dye-Florida)
W70-07642

TURLEY V ARNOLD (DRAINAGE DISTRICT BENEFITS).
51 NE2d 176-183 (Ill 1943).

Descriptors: *Illinois, *Drainage districts, *Benefits, *Assessments, Drainage effects, Drainage programs, Judicial decisions, Legal aspects, Drainage systems, Water policy, Levees, Drains, Ditches, Cost allocation, Benefit sharing, Projects, Project benefits, Water rights, Adjudication procedure, Relative rights, Repulsion (Legal aspects), Riddance (Legal aspects).

Plaintiffs, commissioners of a drainage and levee district, filed a petition for an additional assessment for proposed improvements. Defendants, thirteen property owners, objected to the petition on the grounds that the purpose of the improvements was to give complete drainage to a relatively small area of the district rather than to benefit the entire district. After conclusion of their evidence, defendants requested that the jury view the area of the proposed improvements. The request was granted and the jury was taken over the lands of the district. The trial court's decision confirming the jury's assessment of benefits was reversed by the Illinois Supreme Court. The supreme court held that the trial judge was without authority to permit a jury view of the premises absent a written request before commencement of the trial. The high court also stated that when upper and lower landowners unite in forming a drainage district, the common law principle that the upper landowner is not obligated to assist the lower landowner in removing water is inapplicable. (Powell-Florida)
W70-07644

4B. Groundwater Management

DIRECTIONAL HYDRAULIC BEHAVIOR OF A FRACTURED-SHALE AQUIFER IN NEW JERSEY.,
Geological Survey, Trenton, N.J.
For primary bibliographic entry see Field 02F.
W70-07213

NASHVILLE, C AND ST L RY V RICKERT (REASONABLE USE OF SUBTERRANEAN PERCOLATIONS).

89 SW2d 889-898 (Tenn Ct App 1935).

Descriptors: *Tennessee, *Underground streams, *Reasonable use, *Percolating water, Diversion, Underflow, Legal aspects, Judicial decisions, Watercourses (Legal), Springs, Percolation, Streams, Railroads, Wells, Pumps, Water supply, Land tenure, Relative rights, Pipes, Sinks, Reservoirs, Caves, Cisterns, Groundwater.

Plaintiff railroad company, to supply its water needs, purchased from defendant an acre of land containing a spring. Thereafter, on defendant's remaining land a sinkhole was created which filled with water. Defendant drilled a well thereat and pumped out available water. When this was done, the plaintiff's spring went dry and plaintiff brought suit seeking an injunction to prohibit defendant from pumping so much water as to diminish the flow to plaintiff's spring. The chancellor issued an injunction which allowed defendant to pump water only to the extent that it would not interfere with plaintiff's water supply for his needs. The Tennessee court of appeals affirmed, holding that Tennessee follows the American rule or 'reasonable use' doctrine regarding subterranean percolations. The rights of landowners are correlative and each must use his land so as not to injure the other. Where there is a common source of supply, each owner is limited to reasonable and beneficial use. The facts indicated plaintiff purchased the land for its water supply and that such supply was diminished by defendant's pumping. (Duss-Florida)
W70-07285

OPTIMIZATION OF WELLS AND RECHARGE FACILITIES IN CONJUNCTIVE USE OF GROUNDWATER RESERVOIRS,
California Univ., Davis Dept. of Water Science and Engineering.
Verne H. Scott.
Available from the Clearinghouse as PB-192 092, $3.00 in paper copy, $0.65 in microfiche. California University Water Resources Center Project Completion Report, October 1969. 21 p, 9 fig, 9 ref. OWRR Project No B-006-CALIF.

Descriptors: *Artificial recharge, *Injection wells, *Conjunctive use, *Water management (Applied), Drainage, Dynamic programming, Systems analysis, Water utilization, Surface-groundwater relationships, Bibliographies, Groundwater movement, Drawdown, Discharge (Water).
Identifiers: Well interference.

This investigation of wells and recharge facilities was conducted through a series of related studies dealing with well interference, unsteady recharge flow through injection wells, recharge efficiency of wells and trenches, drainage by wells and the application of dynamic programming. Results of the evaluation, analysis and criteria developed are presented in 5 listed published paper with recommendations of approaches to optimal multisource-multipurpose water allocation in conjunctively managed surface-groundwater-recharge systems. (Knapp-USGS)
W70-07325

CONJUNCTIVE USE SYSTEMS ANALYSIS,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-07328

LARGEST FLOWING WELL IN CANADA AT FORT ST. JAMES,
Robinson, Roberts and Brown Ltd, Vancouver (British Columbia).
W. L. Brown.
Johnson Drillers Journal, p 1-3, March-April 1970. 3 p, 4 fig.

Descriptors: *Water wells, *Artesian wells, Water supply, Aquifers, Alluvium, Glacial drift, Water yield, Water quality.
Identifiers: Fort St. James (B C, Canada).

Fort St. James in British Columbia, Canada, provides its citizens with water from an unusual flowing artesian well. With a free flow of 4,200 gpm, or 6 million gal per day, this is the largest flowing well in Canada and perhaps the largest in North America. The well was completed in November, 1969. The shut-in pressure is 52 psi, equivalent to a head of 120 ft. This permits the town to deliver water into its water system without pumping. The well taps a sand and gravel aquifer about 30 ft thick found in a buried river channel cut into bedrock under Fort St James. Bedrock outcrops at or near the ground surface on both sides of the buried channel, roughly east and west of town. The static water level is 120 ft above ground or 2,420 geodetic. This is 190 ft higher than the water level in Stuart Lake and is higher than all of the major lake and river systems in the area. The water is hard but potable and has a temperature of 48 deg F. (Knapp-USGS)
W70-07361

WATER SITUATION IN MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
For primary bibliographic entry see Field 02F.
W70-07405

WELL SCREENS AND GRAVEL PACKS,
Water Research Association, Medmenham (England).
For primary bibliographic entry see Field 08A.
W70-07437

SOME LEGAL AND ECONOMIC IMPLICATIONS OF SEA-WATER INTRUSION - A CASE STUDY OF GROUNDWATER MANAGEMENT,
Economic Research Service, Washington, D.C. Farm Production Economics Div.
Charles V. Moore, and J. Herbert Snyder.
Natural Resources Journal, Vol 9, p 401-419, 1970. 2 fig, 1 tab, 26 ref.

Descriptors: *Groundwater, *Management, Water law, Economic feasibility, *Encroachment.

Some of the physical characteristics of saltwater intrusion into groundwater basin are described. The legal and economic problems that are encountered in applying various alternatives to the intrusion problem are defined and evaluated. Six such alternatives are considered feasible. The threat of court action by the injured parties due to intrusion causes a change away from the present status quo to one where the pumpers in the contaminated area would be as well off if they contributed to the cost of a fresh water canal rather than suffer the consequences of having the courts adjudicate the basin. This solution leads to maximization of the aggregate profit level of the entire pressure area. (Grossman-Rutgers)
W70-07524

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCE BY DYNAMIC PROGRAMMING,
California Univ., Davis. Dept. of Water Science and Engineering.
Gert Aron.

Univ Calif Water Resources Center, Contrib No 129, June 1969. 157 p, 25 fig, 11 tab, 41 ref. OWRR Project B-006-CAL.

Descriptors: *Optimization, *Dynamic programming, *Conjunctive use, *Surface-groundwater relationships, Water resources, Mathematical models, Water conservation, Pumping, Import, Distribution systems, Computer programs.
Identifiers: Santa Clara Valley.

A mathematical model was developed for a water resource. Linear and dynamic programming techniques were applied to the optimization of the model. The prime objective of the study was (a) to develop a model of a regional water conservation and distribution system under conjunctive use of surface and groundwater and (b) to develop a set of procedures for establishing water allocation and import policies of maximum economic efficiency. As a secondary objective, the study was aimed at the establishment of guidelines for the simplification and segmentation of a water allocation problem followed by a preoptimization of several subsystems, to maximize the number of state and decision variables included in the optimal policy. The Northern portion of the Santa Clara Valley was chosen as a physical model. The proposed procedures of simplification, segmentation and optimization were then applied to the Santa Clara system of water conservation, pumping, import and distribution. The system was represented by three state and twelve decision variables and optimal eight-year policy was developed in intervals of three months. Results of the computer program were discussed and suggestions for further research and improvements were made. (See also W70-07556 and W70-07557) (Thiuri-Cornell)
W70-07555

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCES BY DYNAMIC PROGRAMMING: CHAPTER III-GENERAL APPROACH TO DEVELOPING A PLAN FOR CONJUNCTIVE WATER USE,
California Univ., Davis. Dept. of Water Science and Engineering.
Gert Aron.
In: Univ Calif Water Resources Center, Contrib No 129, p 44-85, June 1969. 41 p, 8 fig. OWRR Project A-006-CAL.

Descriptors: *Optimization, *Dynamic programming, *Conjunctive use, *Surface-groundwater relationships, *Water resources, Water allocation (Policy), Systems analysis, Mathematical models, Long-term planning, California, Decision making.
Identifiers: Residual water value.

The complexity of a typical water resource system under conjunctive use of surface and groundwater was demonstrated. To optimize the allocation of water from several alternative sources to various demand centers, certain simplifictions of a prototype system were proposed in the construction of a conceptual model. The conceptual model system was then subjected to segmentation into subsystems, whose scales of development and/or operations could be optimized independently. The convergence of a dynamic programming decision sequence to a long-term optimal policy was investigated, using a simple hypothetical water allocation model. The concept of 'residual water value' introduced in the Chapter, was tested on the model and found to accelerate the convergence considerable. To test the approaches and procedures proposed in this Chapter, a prototype system, typical of agricultural-urban conjunctive use systems in California, was selected and an optimal water allocation policy for this system was developed. (See also W70-07555) (Thiuri-Cornell)
W70-07556

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCES BY DYNAMIC PROGRAMMING: CHAPTER IV-APPLICATION OF OPTIMIZATION TECHNIQUES TO A PHYSICAL MODEL,
California Univ., Davis. Dept. of Water Science and Engineering.
Gert Aron.
Univ Calif Water Resources Center, Contrib No 129, p 86-145, June 1969. 60 p, 10 fig, 9 tab. OWRR Project A-006-CAL.

Descriptors: *Optimization, *Dynamic programming, *Conjunctive use, *Surface-groundwater relationships, *Water resources, Resource allocation, Constraints, Synthetic hydrology, Computer programs, Water demand.

Dynamic programming as well as several subsidiary analytical techniques were applied to the optimization of a prototype physical model system in which conjunctive ground and surface water management was the prime consideration. Five constraints of the problem were considered. These were represented by fixed demands; limitation on water import, recharge and pipe line capacities, cost functions and physical parameters. The size of the problem was reduced to 3 state variables and 12 decision variables. The Santa Clara Valley system was chosen for an example and a computer program written for the optimization of the system's operation. Optimal allocation schedules under constraint alternatives 1 to 5 were developed for the synthetic sequence of stream flows used. Summaries of the most important consequences of the allocation schedule were presented. The optimization program resulted in an operating schedule which reflected the effects of parametric and cost relationships in a physically logical manner. (See also W70-07555) (Thiuri-Cornell)
W70-07557

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (ADVANTAGES OF THE STATUTE OVER COURT ADMINISTERED RIPARIAN RIGHTS LAW),
For primary bibliographic entry see Field 06E.
W70-07588

PLAINFIELD-UNION WATER CO V BOROUGH OF MOUNTAINSIDE (APPEAL TO SET ASIDE ADMINISTRATIVE APPROVAL OF A PROPOSED PLAN TO INCREASE WATER SUPPLY).
14 NJ 296, 102 A2d 1-7 (1954).

Descriptors: *New Jersey, *Water supply, *Administrative agencies, *Jurisdiction, Legal aspects, State governments, Natural resources, Water shortage, Water policy, Water requirements, Water delivery, Subsurface waters, Well regulations, Water wells, Permits, Regulation, Administration, Water demand, Planning, Projects, Water allocation (Policy), Local governments.

The plaintiff water companies submitted plans to the Water Policy and Supply Council of the State Department of Conservation and Economic Development for obtaining an increased subsurface water supply. This plan was approved, and defendant-borough objected thereto and appealed. There were two basic issues: (1) whether the proofs were insufficient to support the council's findings and (2) whether the Council exceeded its quasi-judicial function. The appellate court found against the appellants. It held that the evidence adduced at the hearing sustained the Council's conclusion that sources of water supply available to the company were inadequate to meet the public's demands. Furthermore, the methods used to adequately fulfill the water needs was peculiarly within the province of the Council. (Barnett-Florida)
W70-07617

4C. Effects on Water of Man's Non-Water Activities

HYDROLOGIC EFFECTS OF PRESCRIBED BURNING AND DEADENING UPLAND HARDWOODS IN NORTHERN MISSISSIPPI,
Forest Service (USDA), Oxford, Miss. Southern Forest Experiment Station.
S. J. Ursic.
USDA Forest Service Research Paper SO-54, 1970. 15 p.

Descriptors: *Burning, *Storm runoff, *Accelerated erosion, *Overland flow, *Peak discharge, Hydrologic aspects, Deciduous forests, Sediment yield, Rainfall-runoff relationships, Small watersheds, Watershed management, Soil erosion, Mississippi.
Identifiers: *Experimental watersheds, *Prescribed burning, *Post-fire erosion.

Reports 3-year results of treatment of two small watersheds consisting of burning the forest floor and deadening the hardwood overstory with a herbicide. Comparisons were against an untreated control watershed. Variables included stormflows, overland flows, peak discharges, and sediment yields. Most of the hydrologic effects were still evident three years after treatment. (Ursic-Forest Service)
W70-07517

THE TECHNICAL SERVICES DESIGN PROBLEM,
Northwestern Univ., Evanston, Ill.
For primary bibliographic entry see Field 06F.
W70-07547

POWELL V EDWARDS (CULVERTS UNDER RAILROAD EMBANKMENT HELD TO INCREASE SURFACE FLOW OVER LOWER LAND).

187 So 716-717 (Ala 1939).

Descriptors: *Alabama, *Culverts, *Embankments, *Surface runoff, Railroads, Engineering structures, Floods, Rainfall, Drainage, Obstruction to flow, Natural flow, Remedies, Judicial decisions, Legal aspects, Slopes, Ditches, Overflow, Flooding, Damages, Land clearing, Riddance (Legal aspects).

Defendant's railroad embankment was adjacent to plaintiff's lands but at a higher elevation. Surface waters coming from land above the embankment ran into a ditch along the embankment and were carried off. As land above the embankment was cleared, surface flow increased and the ditch could not accommodate the increased flow. Defendant therefore constructed two culverts under the embankment which caused an increased flow onto plaintiff's land and resulted in some flooding. Plaintiff sought damages alleging that defendant had impounded water and forced it to flow onto his land with greater force and volume than normal surface flow. The court acknowledged that plaintiff had no legal right to the continuance of the embankment structure which inhibited flow across his land. However, in holding for plaintiff, the court found that the normal surface flow had been increased by the clearing of the upper land, the collecting of the runoff, and the discharging of it through culverts onto plaintiff's land. Since natural drainage would have caused no flooding, plaintiff was entitled to damages. (Hubener-Florida)
W70-07610

NEW ORLEANS AND N E R RY V BURDETTE (OVERFLOW ONTO RIPARIAN LAND CAUSED BY REPLACEMENT OF TRESTLE).
183 So 915-916 (Miss 1938).

Descriptors: *Mississippi, *Culverts, *Excessive precipitation, *Obstruction to flow, Railroads, Engineering structures, Floods, Rainfall, Storms, Rainfall intensity, Embankments, Natural streams, Watercourses (Legal), Relative rights, Judicial decisions, Legal aspects, Water law, Overflow, Natural flow, Flooding, Riparian land, Natural flow.

Plaintiff owned a tract of land adjoining a railroad track. A natural stream ran across his land and under a trestle in the railroad embankment. Defendant railroad replaced the trestle with a small culvert. There had never been any overflow on plaintiff's land prior to the replacement, but after installation of the culvert flooding occurred on several occasions. After a very heavy rain and serious overflow, plaintiff sued for damages. The court held that the culvert should have been constructed with capacity sufficient to accommodate not only normal waters of the stream but also such overflow as past experience should cause the railroad to anticipate. The railroad was liable for any reasonable or unreasonable obstruction of the natural watercourse crossing the embankment. However, the railroad could not be held liable for damages caused by extraordinarily heavy and unprecedented rainfall. The court remanded the case for elimination of the damages attributed to injuries caused by the abnormally heavy rains. (Hubener-Florida)
W70-07612

4D. Watershed Protection

GROWING FOURWING SALTBUSH TRANSPLANTS FOR FIELD PLANTING,
Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.
Earl F. Aldon.
Forest Serv, USDA, Res Note RM-166, 1970. 3 p, 2 fig, 5 ref.

Descriptors: *Plant growth, *Vegetation effects, *Shrubs, *Land management, *Grass lands, Erosion control, Revegetation, Watershed management, New Mexico, Soil erosion.
Identifiers: *Ground cover, Atriplex canescens, Fourwing saltbush.

Seeds can be germinated in plant bands when air temperatures are around 65 deg F. Seedlings should be transplanted when soil moisture conditions are optimum. (Aldon-Forest Service)
W70-07515

AMERICAN SAND AND GRAVEL CO V RUSHING (STREAM BANK EROSION CAUSED BY EXCAVATION ON LOWER RIPARIAN LAND).
For primary bibliographic entry see Field 06E.
W70-07611

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

SIMULTANEOUS DETERMINATION OF CARBON AND OXIDABILITY OF ORGANIC COMPOUNDS IN NATURAL WATERS,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
For primary bibliographic entry see Field 02K.
W70-07201

COMPOSITION OF ORGANIC SUBSTANCES IN THE WATERS OF RESERVOIRS AND LAKES,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
For primary bibliographic entry see Field 02K.
W70-07202

BIODEGRADABLE DETERGENTS FOR THE TEXTILE INDUSTRY,
R. L. Huddleston.
American Dyestuff Reporter, Vol 55, No 2, p P52-P54, 1966.

Descriptors: *Detergents, Biochemical Oxygen Demand, *Biodegradation, Analytical techniques, Textiles, Fibers (Plant).
Identifiers: Foam measurement, Surface tension measurement, Bio-resistance.

Biodegradation studies carried out in commonly accepted test systems and by three analytical methods, including foam and surface tension measurements, demonstrated the biodegradability of primary straight-chain alcohol nonionic structures and the bio-resistance of straight- and branched-chain alkyl phenol nonionic structures. Although biodegradable detergents by their very nature must have a chemical oxygen demand (BOD), studies indicated that BOD values required by primary straight-chain alcohol nonionic products should not noticeably affect total BOD requirements of textile plant effluent waters. (Livengood and Robinson-North Carolina State Univ)
W70-07247

AN AUTOMATED METHOD FOR THE DETERMINATION OF BORON IN SEWAGE, SEWAGE EFFLUENTS AND RIVER WATERS,
Water Pollution Research Lab., Stevenage (England).
L. J. Lionnel.
Analyst, Vol 95, No 1127, p 194-199, 1970. 3 fig, 6 tab, 4 ref.

Descriptors: *Sewage, *Rivers, *Boron, *Sewage effluents, Analytical techniques, Colorimetry, Toxicity, Detergents, Water pollution sources, Instrumentation, Nitrates.
Identifiers: *Technicon AutoAnalyzer, Carminic acid, Perborates.

Reaction of boron with carminic acid in the presence of concentrated sulfuric acid produces a change in color of solution from red to blue. The maximum light absorption for the boron-carminic acid complex is at 590 to 610 nanometers. The colorimetric determination of boron content in sewage, sewage effluents, and river waters is accomplished by means of the Technicon AutoAnalyzer. The limit of detection is about 0.02 milligram of boron per liter, and reproducible results are obtained within the range of the element from 0.10 to 3.00 milligram/liter. The interference of nitrate is reduced by phenol to an acceptable level for aqueous samples containing less than 40 milligram/liter nitrogen. As boron can be toxic to certain plants at concentrations of a few milligram/liter, the method facilitates investigations of pollution caused by perborate bleaches used in detergent products. (Wilde-Wisconsin)
W70-07254

OBSERVATIONS OF EUTROPHICATION AND NUTRIENT CYCLES IN SOME COASTAL PLAIN ESTUARIES,
Johns Hopkins Univ., Baltimore, Md.
J. H. Carpenter, D. W. Pritchard, and R. C. Whaley.
Eutrophication: Causes, Consequences, Correctives, p 210-221. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 9 fig.

Descriptors: *Eutrophication, *Nutrients, *Cycles, *Estuaries, *Coastal plains, Nitrogen compounds, Phosphorus compounds, Temperature, Salinity, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Chlorophyll, Productivity, Phytoplankton, Zooplankton, Pennsylvania, New York, Seasonal, Reservoirs, Industrial wastes, Iron compounds, Sampling, Distribution, Flow rates, Rivers.
Identifiers: Chesapeake Bay, Potomac River, Transparency, Susquehanna River, Carbon fixation, Acartia, Microcystis aeruginosa.

Surveys in northern half of Chesapeake Bay and Potomac iver downstream from Washington, were made monthly for several years. Existing conditions and nutrient levels were determined as a basis for considering increase or reduction in nutrient discharges. Measured were temperature, salinity, dissolved oxygen, pH, alkalinity, chlorophyll, transparency, inorganic phosphate, total filtrate phosphate, total phosphate, nitrate, nitrite, ammonia, total nitrogen, productivity, and net phytoplankton and zooplankton counts. Susquehanna River samples, collected weekly during 1965-1966 monitored the input into upper Chesapeake Bay. A significant part of suspended sediments carried by the Susquehanna River is trapped in reservoirs in lower river reaches. Effects of treated sewage discharges are not observable in Chesapeake Bay below Baltimore. Phosphorus and nitrogen concentrations in estuarine part of the Potomac River during 1965 were not remarkably different from those in upper Chesapeake Bay. High concentrations of chlorophyll in the river below Washington are produced primarily by Microcystis aeruginosa. Zooplankton populations in the Potomac were frequently 3-fold to 5-fold greater than those in upper Chesapeake Bay. Decrease in dissolved oxygen in the lower layer shows that eutrophication may be more pronounced in the estuarine Potomac than phytoplankton counts and chlorophyll concentrations indicate. (See also W70-03975). (Jones-Wisconsin)
W70-07264

RESISTANCE OF FOUR FRESHWATER CRUSTACEANS TO LETHAL HIGH TEMPERATURE AND LOW OXYGEN,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 05C.
W70-07308

INSTRUMENTAL ANALYSIS FOR TRACE ELEMENTS PRESENT IN CHICAGO AREA SURFACE AIR,
Argonne National Lab., Ill. Radiological Physics Div.
S. S. Brar, D. M. Nelson, J. R. Kline, P. F. Gustafson, and E. L. Kanabrocki.
Journal of Geophysical Research, Vol 75, No 15, p 2939-2945, May 20, 1970. 7 p, 2 fig, 4 tab, 4 ref.

Descriptors: *Air pollution, *Trace elements, *Dusts, *Aerosols, *Illinois, Water pollution sources, Smog, Sampling, Data collections, Radiochemical analysis, Neutron activation analysis.
Identifiers: Chicago (Ill), Gamma-ray spectrometry.

On April 4, 1968, surface air particulates were collected on cellulose fiber filters simultaneously at 22 locations throughout the Chicago metropolitan area. A portion of each filter was irradiated with thermal neutrons in Argonne National Laboratory's CP-5 research reactor. The neutron-induced nuclides were analyzed by gamma-ray spectrometry. Twenty trace elements were identified in the surface air. The following elements, listed in decreasing order of concentration, were present: iron, chlorine, aluminum, zinc, manganese, sodium, bromine, vanadium, chromium, antimony, mercury, selenium, cerium, silver, cobalt, lanthanum, scandium, cesium, and europium. The average concentrations varied from 2400 to 0.12 ng/cu m air. (Knapp-USGS)
W70-07343

ATMOSPHERIC NITROUS OXIDE CONCENTRATIONS IN THE HUMID TROPICS,
National Center for Atmospheric Research, Boulder, Colo.
For primary bibliographic entry see Field 02K.
W70-07344

TRACE METAL CHARACTERIZATION IN AQUATIC ENVIRONMENTS BY ANODIC STRIPPING VOLTAMMETRY,
Bureau of Commercial Fisheries, Ann Arbor Mich., and Michigan Univ., Ann Arbor. Dept. of Environmental Health.
H. E. Allen, W. R. Matson, and K. H. Mancy.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 573-581, April 1970. 9 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Water analysis, *Trace elements, *Electrochemistry, *Anodes, Chemical analysis, Analytical techniques, Instrumentation, Nutrients.
Identifiers: Anodic stripping voltammetry, Electrolytic analysis.

Anodic stripping voltammetry may be used for quantitative determination of traces of metals in natural water. Less than 0.1 microgram/liter Pb can be measured in natural waters without preconcentrations of the sample. Metals from the sample are electrodeposited on composite mercury-graphite electrodes. Quantitative determination of the deposited metals is made by anodic stripping using a chronoamperometric technique. With short deposition times the kinetics of complexation of metals with naturally occurring complexing agents may be studied. The rates of exchange of complexing agents may be studied. The rates of exchange of complexed metals after the addition of acid or other metal cations also may be determined. (Knapp-USGS)
W70-07351

AUTOMATIC METHODS FOR DETERMINING NITRATE AND NITRITE IN WATER AND SOIL EXTRACTS,
Norsk Institutt for Vannforskning, Blindern; and Norges Landbrukshoegskole, Vollebekk.
A. Henriksen, and A. R. Selmer-Olsen.
Analyst, Vol 95, No 1130, p 514-518, May 1970. 5 p, 3 fig, 3 tab, 17 ref.

Descriptors: *Water analysis, *Pollutant identification, *Nitrates, *Soil water, *Colorimetry, Nitrites, Analytical techniques, Chemical analysis, Chemical reactions, Automation, Instrumentation, Surface waters.
Identifiers: Automatic nitrate analysis.

Automatic methods for determining nitrate and nitrite in fresh and sea water and in soil extracts with the AutoAnalyzer are described, together with details of the analytical systems. The methods are based on a modification of a manual procedure which consists of reduction of nitrate with copperized cadmium and, with the nitrite thus produced, diazotization of sulphanilamide, the product being coupled with N-1-naphthylethylenediamine to form a highly colored azo dye, which is measured at 520 nm. The methods are capable of analyzing twenty samples per hour. (Knapp-USGS)
W70-07358

REMOTE SENSING ANALYSIS OF WATER QUALITY,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Observation Sciences Dept.
Frank B. Silvestro.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 553-561, April 1970. 9 p, 8 fig, 1 tab, 6 ref.

Descriptors: *Water quality, *Monitoring, *Remote sensing, *Aerial photography, *Spectrometers, Photogrammetry, Infrared radiation, Surveys.
Identifiers: Oneida Lake (NY).

Water pollution studies demand monitoring systems capable of obtaining and analyzing large amounts of data to determine control and abatement measures. Spectral photography is the basis of one such system. Some parameters of interest for pollution studies can be obtained quantitatively from optical density in photographid imagery. Two examples illustrating the feasibility and utility of aerial photographic analysis are presented. Aerially obtained data of Oneida Lake, New York, indicate that the 'red' spectral region may be particularly useful for monitoring water quality. Aerial imagery obtained over a fiber industry effluent plume was analyzed to demonstrate how the data obtained can be used to study the mixing characteristics of receiving waters. (Knapp-USGS)
W70-07362

PRESENT WATER QUALITY IN THE CUYAHOGA RIVER,
Havens and Emerson, Cleveland, Ohio.
For primary bibliographic entry see Field 05B.
W70-07387

ANALYSIS OF MUNICIPAL AND CHEMICAL WASTE WATERS BY AN INSTRUMENTAL METHOD,
Dow Chemical Co., Midland, Mich. Analytical Science Lab.
V. A. Stenger, and C. E. Van Hall.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1755-1763, Oct 1968. 6 fig, 1 tab, 8 ref.

Descriptors: *Analyzer, Concentration, Interference, Oxidation reduction system, Waste water treatment, *Instrumentation.

An instrumental method based on a vapor phase oxidation mass reduction system utilizing carbon monoxide as a reaction product is discussed. Principle of operation and operating conditions is covered. The testing of samples includes primary and secondary municipal waste water, cellulose production wastes, and chemical wastes. Comparison between the instrumental (CO2D) and conventional (COD and TOC) tests are made. Results show comparable COD and CO2D values. A number of common compounds has shown results within 5% of the theoretical COD values. The results on some others particularly volatile compounds, such as phenol or acetone may be low by 10-15%. The presence of chloride (500 mg/l NaCl) raises results by about 10 mg/l at the 100-200 mg/l COD level. (Hancuff-Texas)
W70-07461

CHARACTERIZATION OF INDUSTRIAL WASTES BY INSTRUMENTAL ANALYSIS,
Ontario Water Resources Commission, Toronto.
H. A. Clarke.
Proceedings of the Industrial Waste Conference, 23rd, pt 2, p 26-34, 1968.

Descriptors: *Analytical techniques, *Industrial wastes, Chromatography, Spectrophotometry, Polarographic analysis, Metals, Organic compounds, Pesticide residues, Activated carbon.

Instrumentation and techniques used in a large chemistry laboratory for the analysis and characterization of industrial wastes are described. Instrumentation, basic principles and general methods of analysis are discussed including: polarography and atomic adsorption spectrophotometry for the analysis of metals, ultra-voilet and infrared spectrophotometry for the identification of some organics and gas and thin layer chromatography methods for the analysis of pesticide residues. In addition, examples of the application of this type of instrumentation to samples collected by carbon adsorption are described. (Sorber-Texas)
W70-07468

AUTOMATIC MEASUREMENT OF TOTAL OXYGEN DEMAND,
Dow Chemical Co., Midland, Mich.
Dennis A. Clifford.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 832-848, 9 fig, 7 tab, 6 ref.

Descriptors: *Chemical oxygen demand, Analysis, Waste water treatment, Instrumentation.
Identifiers: *Total oxygen demand (TOD), *TOD analyzer, Oxidation reaction, Calibration curve, Reaction efficiency, Plant effluent.

The need for a more accurate method of determination of oxygen demand is emphasized. To meet this need The Dow Chemical Company has developed the total oxygen demand analyzer (TOD). This instrument affords a very rapid and precise method for determination of oxygen demand. The developed method measures directly and quantitatively the amount of gaseous oxygen required to oxidize the nonaqueous constituents of a water sample. The reaction efficiency is very nearly equal to the theoritical without significant interference from the common sources. Because of the severity of oxidizing conditions, i.e., 900 deg C over platinum the method has been named Total Oxygen Demand method. The TOD analyzer is fully automatic in its functions of sampling and anlyzing, requiring a total time of 2 - 4 minutes per sample. Correlation of this method with the standard dichromate COD method has been very good on waste water analysis. The TOD analyzers have successfully operated over several instrument years as a device for laboratory and process analysis of water and waste water. (Shankar-Texas)
W70-07497

APPLICATION OF THE TOTAL CARBON ANALYZER FOR INDUSTRIAL WASTEWATER EVALUATION,
Texas Univ., Austin.
Davis L. Ford.
Proceedings of the Industrial Wastes Conference, 23rd, 1968. p 989-999, 4 fig, 5 tab, 12 ref.

Descriptors: *Biochemical oxygen demand, *Chemical oxygen demand, Industrial wastes, Instrumentation, Wastes, Waste treatment.
Identifiers: *Total organic carbon, Correlation.

The carbon analyzer provides a rapid and simple means of determining the organic levels in aqueous solutions. The total organic carbon, TOC, test is free of many of the variables which affect the BOD and COD analyses. In attempting to correlate TOC to BOD or COD certain limitations should be recognized, namely: a portion of COD is attributable to inorganics; the BOD and COD tests do not include resistant organic compounds; and the BOD test is susceptible to many variables. Theoretically, the COD/TOC ratio ranges from zero, when the organic material is resistant to degradation, to 5.33 for methane. Values cited from several industrial wastewaters range from 1.75 to 6.65. For waste streams of relatively constant character a COD-TOC relationship may be developed. It has been difficult to correlate BOD with TOC with industrial wastes, but relatevely good correlations have been obtained with domestic wastes. Ratios of five-day BOD to TOC of 1.35 - 2.62 have been reported. Both the COD/TOC and BOD/TOC ratios decrease during biological oxidation. (DiFilippo-Texas)
W70-07500

5B. Sources of Pollution

COPPER SULFATE IN FLOODED CRANBERRY BOGS,
Massachusetts Univ., East Wareham. Cranberry Experiment Station.
Karl H. Deubert, and Irving E. Demoranville.
Pesticides Monitoring Journal, Vol 4, No 1, p 11-13, June 1970. 3 p, 1 tab, 7 ref.

Descriptors: *Algicides, *Copper sulfate, *Cranberries, *Bogs, *Massachusetts, Path of pollutants, Water chemistry, Pesticides, Water pollution sources, Sampling, Water analysis, Data collections.
Identifiers: Cranberry bogs.

Cranberry bogs are treated with copper sulfate to control algal growth. In order to assess possible water pollution after release of treated floodwater into streams and ponds, the rate at which copper disappeared from the water after treatment was monitored in two separate bogs. In both bogs the concentration of copper 25 hours after application was higher than expected due to smaller volumes of floodwater. During the first 6 days after treatment, copper concentrations decreased rapidly, and after 10 days about 95% of the copper had disappeared. When floodwater was released about 4 weeks after treatment, the concentration of copper was at the same level found in the water prior to treatment. (Knapp-USGS)
W70-07156

PESTICIDE RESIDUES IN HALE COUNTY, TEXAS, BEFORE AND AFTER ULTRA-LOW VOLUME AERIAL APPLICATION OF MALATHION,
Communicable Disease Center, Savannah, Ga.
G. O. Guerrant, L. E. Fetzer, Jr., and J. W. Miles.
Pesticides Monitoring Journal, Vol 4, No 1, p 14-20, June 1970. 7 p, 2 fig, 6 tab, 5 ref.

Descriptors: *Water pollution sources, *Pesticide residues, *Texas, Pesticide kinetics, Pest control, Spraying, Public health.
Identifiers: *Malathion residues.

In ultra-low volume aerial sprayings of malathion for control of arthropod-borne encephalitis in 1967 in Hale County, Texas, the amount of malathion deposited was determined by measuring the amount found on exposed filter papers; the average concentration found was 1.5 mg/sq ft, or 65% of the applied dosage. The maximum concentration found in environmental waters was 0.5 ppm malathion, which decomposed with a half-life of 0.5 to 10 days, depending upon pH. Methods for collecting, transporting, and determining malathion residues are described. The chlorinated hydrocarbon residues present in the spray area were monitored also and found to consist mainly of DDT and BHC isomers. Most of the sampled waters contained less than 1 ppb of the individual chlorinated pesticides. (Knapp-USGS)
W70-07159

HYDROGEOLOGY AND WATER QUALITY STUDIES IN THE CACHE LA POUDRE BASIN, LARIMER AND WELD COUNTIES, COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
James P. Waltz.
Available from the Clearinghouse as PB-192 088, $3.00 in paper copy, $0.65 in microfiche. Natural Resources Center, Colorado State University, Partial Completion Report, June 30, 1969. 34 p, 7 fig, 2 plate, 2 tab, 9 ref. OWRR Project No A-001-COLO (7).

Descriptors: *Water quality, *Hydrogeology, *Colorado, *Water pollution sources, *Water pollution effects, Model studies, Analog models, Water chemistry, Mineralogy, Clay minerals, Runoff, Erosion, Groundwater movement, Surface waters.
Identifiers: Cache la Poudre basin (Colo).

The Cache la Poudre basin, Larimer County, Colorado, provides an ideal laboratory for study and documentation of the causes and effects of water quality deterioration. It has been possible to correlate downstream changes in quality of surface water and groundwater to environmental factors including both natural and man-induced conditions. Approximately half of the basin lies in mountainous terrain on the eastern slope of the Rocky Mountains in northern Colorado. Here, the effects of man's activities on the movement and quality of water have been relatively minor. Applications of geophysics, analog modelling techniques and studies of clay mineralogy were used in defining the geologic framework in the basin and evaluating the effect of geology on the quality of groundwater. (Knapp-USGS)
W70-07167

INDUSTRIAL APPLICATIONS OF STARCHES IN THE PAPER AND TEXTILE INDUSTRY,
For primary bibliographic entry see Field 05D.
W70-07239

BIODEGRADABLE DETERGENTS FOR THE TEXTILE INDUSTRY,
For primary bibliographic entry see Field 05A.
W70-07247

FACTORS INFLUENCING THE HERBICIDAL EFFICIENCY OF MCPA AND MCPB IN THREE SPECIES OF MICRO-ALGAE,
University of Strathclyde, Glasgow (Scotland). Dept. of Biology.
For primary bibliographic entry see Field 05F.
W70-07255

DISPOSAL OF LIQUID WASTES INTO COASTAL WATERS,
Battelle Memorial Inst., Richland, Wash.
W. L. Templeton.
Chemical Engineering Progress, Vol 66, No 2, p 45-50, 1970. 6 fig, 31 ref.

Descriptors: *Waste disposal, *Radioactive waste disposal, *Waste water (Pollution), Dispersion, Discharge (Water), Nuclear power plants, Nuclear wastes, Radioactivity effects, Fish, Predation, Oysters, Human pathology, Pesticides, Chlorinated hydrocarbon pesticides, Sea water, Coasts.
Identifiers: *England, Dilution, Strontium-90, Zinc-65, Cobalt-60, Porphyra umbilicalis, Half-life, Radionuclides, Windscale Plant (England), Bradwell Station (England), Ruthenium-106.

The danger to man from disposal of radioactive wastes is now probably better understood than any other industrial risk. Aside from the dose limits set by International Commission on Radiological Protection, the permissible discharge rates depend on the concept of critical populations, as well as degree of dilution, dispersion, and reconcentration of radionuclides. The external and internal exposure of both physical and biologic nature are additional factors delineating the disposal of radioactive wastes. The situation is comprehensibly illustrated as it now exists at the discharge points of English coastal waters. Exapmples include Ruthenium-106, Strontium-90, Zinc-65, Cobalt-60, and critical material, such as Porphyra umbilicalis, an edible seaweed, fish, oysters, and either the total body of man or his lower large intestine. The approach of the United Kingdom toward disposal of radioactive wastes is considered with reference to disposal of other pollutant materials. A similarity of chlorinated hydrocarbons with radionuclides is pointed out. (Wilde-Wisconsin)
W70-07278

ENHANCEMENT BY GLYCEROL OF PHOTOTROPHIC GROWTH OF MARINE PLANKTONIC ALGAE AND ITS SIGNIFICANCE TO THE ECOLOGY OF GLYCEROL POLLUTION,
Fisheries Research Board of Canada, Vancouver, (British Columbia). Vancouver Lab.
Joseph Y. Cheng, and Naval J. Antia.
Journal Fisheries Research Board of Canada, Vol 27, No 2, p 335-346, 1970. 2 fig, 2 tab, 16 ref.

Descriptors: *Pollutants, *Sea water, *Algae, *Marine algae, Cultures, Phytoplankton, Cytological studies, Cyanophyta, Chlorophyta, Chrysophyta, Rhodophyta, Testing, Ecology.
Identifiers: *Glycerol, Photoheterotrophic growth, Luminarin-type polysaccharides, Cryptophycea, Dinophycea, Baccilariophycea, Prymnesium parvum, Photoautotrophs, Chroomonas salina.

Eighteen species of marine phytoplankters were grown in axenic culture of sea water enriched in nitrate, orthophosphate, silicate, trace-metal ions, and vitamines, and buffered at pH 7.6-7.8. Aside from Prymnesium parvum and Chroomonas salina, none of the species showed growth on glycerol in the absence of light. Under illumination, glycerol stimulated the growth of 16 species particularly that Chrysophycea, Cryptophyceae, Phaedactylum tricornutum, Porphyridium cruentum, and Nannochloris oculata. The growth of some species was inhibited by glycerol at different concentrations. The effects of compound suggested its relation to photoheterotrophic growth. In some cases glycerol induced obvious cytological and metabolic changes. The ecological implications of glycerol pollution of sea water are discussed. (Wilde-Wisconsin)
W70-07280

THE LANGE-KUENTZEL-KERR THESIS.

Canadian Research and Development, March 1970. 8 p, 1 fig, 1 tab, 14 ref.

Descriptors: *Eutrophication, *Phosphorus, *Carbon, Bacteria, Algae, Symbiosis, Carbon dioxide, Nitrogen, Lakes, Estuaries, Nutrients, Detergents, Wisconsin, Lake Erie, Lake Ontario, St Lawrence River, International Joint Commission.
Identifiers: *Carbonaceous material, *Canadian phosphate detergent ban, Wyandotte Chemical Corporation, FMC Corporation, Soap and Detergent Association, Carboy trials, Canada, Nitrogen: phosphorus ratio.

Reports by W Lange (Nature Vol. 215, No. 5107: 1277-1278, Sep 17, 1967), L E Kuentzel (Journal Water Pollution Control Federation: 1737-1747, Oct 1969), and P C Kerr (unpublished) are cited defending the thesis that carbonaceous material, not phosphorus, is the factor controlling the process of eutrophication. As additional proof of the minor role of phosphorus and nitrogen in the growth of algae, the report includes the result of an experiment conducted in two small oligotrophic lakes in Florida. Addition of phosphate and nitrogen fertilizers to one of these organic matter-free lakes failed to alter significantly the trophic state of the lake and the density of planktonic organisms. The issue in question is of a far-reaching importance as it is relevant to the USA and Canadian government action restricting phosphate enriched effluents of soap and detergents into Erie and Ontario Lakes and the international section of the St Lawrence River. (Wilde-Wisconsin)
W70-07283

CONTRIBUTION TO THE RESIDENCE TIME OF SULFUR DIOXIDE IN A POLLUTED ATMOSPHERE,
Federal Board of Health, Berlin (West Germany). Inst. of Water Soil, and Atmospheric Hygiene.
Erich Weber.
Journal of Geophysical Research, Vol 75, No 15, p 2909-2914, May 20, 1970. 6 p, 4 fig, 6 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Sulfur compounds, *Dispersion, *Air pollution, Smoke, Thermal powerplants, Carbon dioxide, Mixing, Oxidation, Air pollution effects.
Identifiers: Sulfur dioxide, Atmospheric chemistry, Frankfurt am Main (Germany).

The atmospheric oxidation of sulfur dioxide was studied because of its importance in atmospheric pollution. Oxidation or absorption of sulfur dioxide is of interest, since it shortens the residence time and leads to lower ground-level concentrations. Initially the oxidation is quite rapid (almost 30% in about 100 min) for humidities above 70%. In Frankfurt am Main the concentration of air pollutants, wind direction and speed, air temperature, and relative humidity have been continuously recorded for several years. In certain cases short-term peaks (5 to 15 min) of carbon dioxide and sulfur dioxide concentrations can be defined as an in-

fluence of power station effluents. Carbon dioxide is almost inert, whereas the proportion of sulfur dioxide can decrease by oxidation or absorption while being transported through the atmosphere. Air quality measurements in Frankfurt am Main estimate a loss of almost 50% of the total sulfur content in a period of 20 min to 1 hour, depending on meteorological conditions. (Knapp-USGS)
W70-07333

INTERNATIONAL SYMPOSIUM ON ATMOSPHERIC TRACE CONSTITUENTS AND ATMOSPHERIC CIRCULATION.
For primary bibliographic entry see Field 02B.
W70-07336

TRACE ELEMENT CONCENTRATIONS IN THE TROPOSPHERE AND LOWER STRATOSPHERE.,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 02K.
W70-07338

THE SEASONAL VARIATION IN THE CONCENTRATION OF STRONTIUM 90 IN RAIN AND ITS DEPENDENCE ON LATITUDE,
Heidelberg Univ. (West Germany). Physikalisches Institut (II).
D. H. Ehhalt, and G. Haumacher.
Journal of Geophysical Research, Vol 75, No 15, p 3027-3031, May 20, 1970. 5 p, 2 fig, 9 ref.

Descriptors: *Fallout, *Strontium radioisotopes, *Rainfall, *Latitudinal studies, *Seasonal, Sampling, Data collections, Statistical methods, Atmospheric physics, Air pollution, Tracers, Tracking techniques, Distribution patterns.
Identifiers: Sr-90 deposition.

Seasonal variations in Sr-90 deposition averaged over latitudinal belts 10 deg wide were calculated from monthly means obtained from a rainfall network and averaged over four years, 1963-1966 inclusive. Similar calculations were made for the Sr-90 concentration in rain and a deposition corrected for the seasonal variation in rainfall. In the northern hemisphere the seasonal variation of the Sr-90 concentration and the rainfall-corrected deposition exhibit the same systematic trend. A southern mode, which reached a maximum Sr-90 deposition in March, as well as a northern mode which does not reach a maximum before June were observed. The seasonal variations at intermediate latitudes change gradually from one pattern to the other. (Knapp-USGS)
W70-07340

DAILY VARIATIONS IN THE TRITIUM CONCENTRATION OF ATMOSPHERIC MOISTURE,
Gakushuin Univ., Tokyo (Japan). Dept. of Chemistry.
Kunihiko Kigoshi, and Kazuo Yoneda.
Journal of Geophysical Research, Vol 75, No 15, p 2981-2984, May 20, 1970. 4 p, 8 fig, 5 ref.

Descriptors: *Tritium, *Fallout, *Tracers, *Hydrologic cycle, Oceans, Sea water, Humidity, Tropical regions, Air circulation.
Identifiers: Japan.

Observed daily variations in the tritium concentration of atmospheric moisture collected in Tokyo from May 10 to June 2, 1966, and from July 12 to August 6, 1968, are presented. The relation between tritium concentration variations and the movement of air masses over Tokyo is discussed. High tritium concentrations indicate the arrival of continental air masses from the north, and low tritium concentrations indicate the presence of oceanic air masses. The tritium concentrations in tropical low-pressure air masses were nearly equal to that of surface ocean water. (Knapp-USGS)
W70-07341

CONCENTRATION PROFILES DOWNSTREAM FROM INSTANTANEOUS POLLUTION LOADINGS,
Midwest Research Inst., Washington, D.C., and Midwest Research Inst., Kansas City, Mo.
T. D. Bath, A. E. Vandegrift, and T. S. Hermann.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 582-595, April 1970. 14 p, 11 fig, 2 tab, 4 ref.

Descriptors: *Path of pollutants, *Tracers, *Dye releases, *Mathematical models, Diffusion, Mixing, Dispersion, Sorption, Streamflow, Turbulent flow, Eddies, Vortices.
Identifiers: Topeka (Kans).

Experimental investigations were carried out in the field to observe the downstream distribution of pollutants entering the stream instantaneously at a point. The observations were made on a small stream near Topeka, Kansas, over a distance of more than 10 miles from the point of injection of the pollutants. The data obtained are correlated well by a mathematical model that assumes that the basic mechanisms of pollutant transport are mixing by eddy diffusion and sorption due to stream boundary interactions. The distribution shows broadening of the peak area of concentration lowering of the peak, and 'tailing' as the pollutant moves downstream. A model was developed for pollutant dispersion in streams, pollutant transport in streams, and stability and conservation of the materials injected into the stream (sodium fluorescein and encapsulated rhodamine B dyes). (Knapp-USGS)
W70-07363

A METHOD FOR PREDICTING POLLUTANT TRANSPORT IN TIDAL WATERS,
Calif., University, Berkeley. Hydraulic Lab.
Hugo B. Fischer.
California University Water Resources Center Contribution No 132, Berkeley, March 1970. 143 p, 8 fig, 9 tab, 21 ref. Project W-165 UC-WRC; NSF Grant GK-3210.

Descriptors: *Computer programs, *Mathematical models, *Currents (Water), *Estuaries, *Path of pollutants, Mixing, Dispersion, Diffusion, Dissolved oxygen, Systems analysis, Rivers, Streamflow, Tides.
Identifiers: Pollutant transport model.

A numerical tidal pollutant-transport model is presented in two parts; part one models the tidal hydraulics of an estuary and determines tidal velocities and elevations; part two models the transport and dispersion of pollutants. The only input required is the tidal fluctuation of water surface at the estuary mouth and the geometry and frictional characteristics of the estuary. The model may be used to predict pollutant distributions from discharges in existing estuaries, or to determine effects on pollution caused by changing the estuarine geometry. (Knapp-USGS)
W70-07366

POLLUTION IN THE MISSISSIPPI RIVER,
Federal Water Pollution Control Administration, Chicago, Ill.; and Federal Water Pollution Control Administration, Dallas, Tex.
H. W. Poston, and W. C. Galegar.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 33-42, 1969. 10 p, 7 fig, 13 tab.

Descriptors: *Mississippi River, *Water pollution sources, *Water pollution effects, Pollutants, Solutes, Aquatic bacteria, Monitoring, Organic matter, Data collections, Water quality.

The Mississippi River, one of the world's largest watercourses, serves as a source of water for many uses: drinking, swimming, boating, commercial and sports fishing, navigation, and industrial water supply. Most sections of the river have experienced pollution problems. Federal enforcement conferences have been held at Minneapolis-St. Paul, St. Louis, and New Orleans. The New Orleans area, at present, is experiencing taste and odor problems in drinking water. Concentrations of organics, metals, and chlorides in the river are increasing. Through the water quality standards program, a state-federal partnership has been forged to improve management of water resources such as the Mississippi. (See also W70-07380). (Knapp-USGS)
W70-07384

PRESENT WATER QUALITY IN THE CUYAHOGA RIVER,
Havens and Emerson, Cleveland, Ohio.
George D. Simpson, and Lamont W. Curtis, Jr.
In: Water-1969, Chemical Engineering Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 64-74, 1969. 11 p, 8 fig.

Descriptors: *Water quality, *Water pollution, *Rivers, *Ohio, *Surveys, Water pollution sources, Water pollution effects, Dissolved oxygen, Biochemical oxygen demand, Industrial wastes, Municipal wastes, Coliforms, River basin development, Water resources development, Planning.
Identifiers: Cuyahoga River (Ohio).

A study of the water quality of the Cuyahoga River in Northeast Ohio was made. The purpose was to define the present water quality and to project future qualities by using alternative methods of treatment of waste water and flow augmentation. Extensive basic data collection included the chemical, physical, and biological characteristics. A dissolved oxygen model was constructed, and the alternative methods were investigated with respect to meeting the recommended water quality criteria. (See also W70-07380) (Knapp-USGS)
W70-07387

INTERNATIONAL CONFERENCE ON OIL POLLUTION OF THE SEA.
For primary bibliographic entry see Field 05C.
W70-07411

ESTUARINE POLLUTION IN THE STATE OF HAWAII. VOL. I: STATEWIDE STUDY,
Hawaii Univ., Honolulu. Water Resources Research Center.
Doak C. Cox, and Lawrence C. Gordon, Jr.
Technical Report No 31, March 1970. 151 p, 17 tab, 46 fig, 103 ref. FWQA Contract 14-12-446.

Descriptors: *Estuaries, *Hawaii, *Water pollution, Water quality, Water pollution sources, Pollutants.

Estuaries, for this study, are defined as either bays receiving fresh water discharge from land or tidal portions of stream mouths. Potential pollution of estuaries in Hawaii is related to land and estuarine useages. Existing water quality data for the estuaries is compared with water quality standards adopted for the state. For 89 estuaries identified, the water quality data is insufficient to form any basis for judgement as to relation to standards pertinent to 17 and that the quality does not meet the standards pertinent to 26. In 21 estuaries the quality definitely does not meet the standards. Some of the tolerances established in the standards are questionable, and assignments of some of the estuaries to water quality classes is questionable. A selected bibliography of 176 references is also included.
W70-07513

5C. Effects of Pollution

TEMPERATURE AND MANGANESE AS DETERMINING FACTORS IN THE PRESENCE

OF DIATOM OR BLUE-GREEN ALGAL FLORAS IN STREAMS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
Ruth Patrick, Bowman Crum, and John Coles.
Proceedings of the National Academy of Sciences, Vol 64, No 2, p 472-478, 1969. 2 tab, 10 ref.

Descriptors: *Streams, *Algae, *Diatoms, Temperature, Manganese, Cultures, Recirculated water, Nitrates, Phosphates, Sodium, Water pollution effects, Laboratory tests.
Identifiers: Green algae, Blue-green algae, Temperature experiments, Recycled water.

Trials conducted in culture boxes indicated that at an average temperature of 34-38C blue-green algae tend to replace diatoms. Both blue-green and green algae, commonly found in polluted waters, were favored by media with manganese concentration of only a few parts per billion. An average concentration of manganese of 0.02-0.043 milligram/liter in natural streams and 0.04-0.28 milligram/liter in recycled water experiment favored domination of diatom flora. Increase in nitrate and phosphate content of water failed to influence the flora of free-flowing streams, but promoted the growth of blue-green and green algae in recycled water of a low manganese content. (Wilde-Wisconsin)
W70-07257

THE UNSEEN PROBLEMS OF THERMAL POLLUTION,
Miami Univ., Fla. Inst. of Marine Science.
Donald P. de Sylva.
Oceans, Vol 1, No 1, p 37-41, 1969.

Descriptors: *Thermal pollution, Aquatic environment, Sewage, Industrial wastes, Water quality, Agriculture, Domestic wastes, Electric power plants, Fuels, Nuclear powerplants, Temperature, Killifishes, Marine microorganisms, Coasts, Oceans, Estuaries, Enzymes, Metabolism, Growth rates, Reproduction, Diseases, Food chains, Salinity, Alaska, Florida, Technology.
Identifiers: Atomic wastes, Temperature oscillations, Newfoundland.

Conventional power plants, using fossil fuels, raise the water temperature by about 10-30F. Nuclear power stations use much more water for cooling and return it to the environment at even higher temperatures. An increase of even one or two degrees may cause biological changes because of the many interacting factors between the organisms and the environment. The healthy upper limit of activity for most adult aquatic organisms is at about 90F; many temperate-water organisms cease activity at about 79F. Increased temperature is usually more detrimental during early development. Fresh water quality standards have been formulated, but arriving at standards for salt water is more difficult because of the complex nature of sea water. Adequate pollution control technology is available to industry and should be included in plant designs. While it is seldom possible to perform all the long-term studies needed to predict the varied effects of heated water, scientists have a number of simple but elegant principles of biology, chemistry, and physics, enabling rough but effective predictions of potential effects of water temperature increase upon the environment. (Jones-Wisconsin)
W70-07260

EUTROPHICATION IN NORTH AMERICA,
Washington Univ., Seattle.
W. T. Edmondson.
Eutrophication: Causes, Consequences, Correctives, p 124-149. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 6 fig, 4 tab, 70 ref.

Descriptors: *Eutrophication, *Nuisance algae, *Sewage, Water pollution sources, Water pollution effects, Phosphorus, Nitrogen, Chlorophyll, Productivity, Regional analysis, Reservoirs.
Identifiers: Nutrient budgets, Lake Sebasticook (Me), Lake Winnisquam (N H), Madison lakes (Wis), Lake Washington (Wash), Nuisance conditions.

Examples of artificial enrichment are given. Well-documented histories of the effects of artificial enrichment are not common. Case histories are available for four lakes or lake systems: Lake Sebasticook, Maine; Lake Winnisquam, New Hampshire; the Madison, Wisconsin, lakes; and Lake Washington, Washington. In each case, artificial enrichment occurred by sewage effluent input; Sebasticook also received large inputs of industrial wastes high in nutrients and organic matter. Artificial enrichment in all cases has resulted in lowered transparency, Myxophycean blooms and nuisance conditions of surface scum and odor. Diversion of sewage effluents has led to improved conditions in Lake Washington and the Madison Lakes Monona and Waubesa, although Lake Mendota appears to be deteriorating. One of the major features of the investigations of artificial enrichment in North American lakes is the development of nutrient budgets. This approach needs further development and refinement, and with continued development of bioassay techniques can be expected to aid future investigations. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07261

EUTROPHICATION, PAST AND PRESENT,
Yale Univ., New Haven, Conn.
For primary bibliographic entry see Field 02H.
W70-07262

BACTERIA IN LAKES: POPULATIONS AND FUNCTIONAL RELATIONS,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 02H.
W70-07263

OBSERVATIONS OF EUTROPHICATION AND NUTRIENT CYCLES IN SOME COASTAL PLAIN ESTUARIES,
Johns Hopkins Univ., Baltimore, Md.
For primary bibliographic entry see Field 05A.
W70-07264

EASTERN EUROPEAN LAKES,
Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
For primary bibliographic entry see Field 02H.
W70-07265

THE PROCESS OF EUTROPHICATION IN CENTRAL EUROPEAN LAKES,
Zurich Univ. (Switzerland); and Zurich Univ. (Switzerland). Cantonal Lab.
For primary bibliographic entry see Field 02H.
W70-07266

CRYSTALLIZATION OF EUTROPHICATION CONCEPTS IN NORTHERN EUROPE,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 07B.
W70-07267

THE ENRICHMENT OF STREAMS,
Waterloo Univ. (Ontario).
H. B. N. Hynes.
Eutrophication: Causes, Consequences, Correctives, p 188-196. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 40 ref.

Descriptors: *Eutrophication, *Streams, *Rivers, Primary productivity, Organic matter, Nutrients, Nitrogen, Phosphorus, Aquatic plants, Water pollution sources, Water pollution effects, Impoundments, Phytoplankton.
Identifiers: Enrichment, Water courses.

The term eutrophic, with its connotations of aging and evolution, cannot be properly applied to running water. Streams change along their length, increasing in discharge, width, depth, temperature, and transport of suspended matter and dissolved solids. Running water tends to be more fertile than standing water, but primary production is patchy due to turbulence and washout conditions. Community respiration is greater than photosynthesis in all but the most highly enriched streams. Input of sewage effluent enriches streams by increasing allochthonous organic matter near the effluent source and by increasing the concentrations of nutrient salts farther downstream. Additional nutrient inputs occur through leaching of agricultural soils (Wisconsin data--12 lb nitrate nitrogen and 0.6 lb phosphate/square mile per day). Land clearing, channelization and swamp drainage have converted streams into better producers. Stream floras tend to be opportunistic species (Myriophyllum, Potamogeton, Cladophora, Oscillatoria) which will invade newly-enriched substrates. Production of large rivers is dominated by planktonic diatoms and rotifers; turbidity appears to be major limiting factor. High temperatures, low discharges and low turbidities as found in impoundments are favorable for the development of Chlorophycean and Myxophycean flora and resultant increase of primary production. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07268

CHANGES IN THE ENVIRONMENT AND BIOTA OF THE GREAT LAKES,
Wisconsin Univ., Madison.
A. M. Beeton.
Eutrophication: Causes, Consequences, Correctives, p 150-187. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 15 fig, 1 tab, 76 ref.

Descriptors: *Sediments, *Eutrophication, *Great Lakes, Lake Michigan, Lake Superior, Lake Huron, Lake Erie, Lake Ontario, Nitrates, Water pollution sources, Water pollution effects, Physicochemical properties, Benthos, Fish populations, Dissolved solids, Dissolved oxygen, Sulfates.
Identifiers: Chlorides, Literature review, Green Bay, Saginaw Bay.

Although concern over changes in the Great Lakes has existed for many years, the idea that the lakes are undergoing accelerated eutrophication is recent. Environmental changes can be considered in three categories: pollution of inshore areas, long-term changes in open waters, and changes in sediments. On the basis of accepted physiocochemical characteristics, Lakes Superior, Michigan, and Huron are oligotrophic, Lake Eris is eutrophic and Lake Ontario is in an intermediate condition. Superior remains oligotrophic, except for localized pollution; changes in fish stocks are traceable to commercial fishing and predation by lamprey. Lakes Michigan and Huron have undergone changes involving dissolved oxygen, total dissolved solids and biota which indicate increasing eutrophy, especially in Green and Saginaw Bays. Lake Erie has shown major changes in limnological factors and biota; effects of increased pollution and eutrophication of Erie have spread to Lake Ontario. The most important changes apparently are those occurring in sediments owing to the contribution of large quantities of allochthonous materials resulting from urbanization and industrialization. Changes in sediments are important factors in the observed changes in limnological factors and fish populations. Abatement of present conditions in Lake Erie is theoretically possible. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07269

EUTROPHICATION INDICES AND THEIR RELATION TO OTHER INDICES OF ECOSYSTEM CHANGE,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 07B.
W70-07270

EUTROPHICATION OF ESTUARIES,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02L.
W70-07271

EUTROPHICATION AND CHANGES IN THE COMPOSITION OF THE ZOOPLANKTON,
Yale Univ., New Haven, Conn.
John Langdon Brooks.
Eutrophication: Causes, Consequences, Correctives, p 236-255. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 2 fig, 2 tab, 43 ref.

Descriptors: *Eutrophication, *Zooplankton, Feeding rates, Predation, Copepods, Daphnia, Lakes, Water pollution effects, Indicators, Phytoplankton.
Identifiers: *Literature review, Selective predation, Enrichment, Cladocera, Bosmina.

Truly herbivorous zooplankton of trophic importance are limited to the Cladocera and calanoid Copepoda. Enrichment of lake ecosystems leads to an increase in standing crop of phytoplankton and to a lesser degree, zooplankton. Increases in standing crops of zooplankton species are controlled or modified by several factors, including standing crop and size of phytoplankton, size-selective feeding by zooplankton, size-selective predation by planktivores and differential feeding effectiveness among zooplankton species. In the absence of planktivorous predators, larger forms (Daphnia, Mesocyclops, Epischura) will tend to dominate the zooplankton; size selective predation on zooplankton will result in dominance of smaller forms (Bosmina, Ceriodaphnia, Tropocyclops). Dominance of larger forms will tend to produce more 'oligotrophic' characteristics of the water; dominance of smaller forms will produce more 'eutrophic' characteristics. Sizes of zooplankters in Lakes Michigan and Erie supports this generalization. Species shifts within the genus Bosmina have been interpreted as indicating enrichment; they may, however, be caused or modified by predation or competition. Chemical enrichment may adversely affect populations of planktivorous fish, this change in turn will alter the composition of the zooplankton. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07272

ASIAN LAKES,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
For primary bibliographic entry see Field 02H.
W70-07273

BIOLOGICAL EFFECTS AND PERSISTENCE OF DURSBAN* IN FRESHWATER PONDS,
California Univ., Riverside. Dept of Entomology; and Bureau of Sport Fisheries and Wildlife, Davis, Calif.
For primary bibliographic entry see Field 02H.
W70-07276

BENTHIC FAUNA COLONIZATION OF A NEW RESERVOIR WITH PARTICULAR REFERENCE TO THE CHIRONOMIDAE,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-07279

THE LANGE-KUENTZEL-KERR THESIS.
For primary bibliographic entry see Field 05B.
W70-07283

RESISTANCE OF FOUR FRESHWATER CRUSTACEANS TO LETHAL HIGH TEMPERATURE AND LOW OXYGEN,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
J. B. Sprague.
Journal of the Fisheries Research Board of Canada, Vol 20, No 2, p 387-415, 1963. 15 fig, 2 tab, 40 ref.

Descriptors: *Crustaceans, *Isopods, *Temperature, *Dissolved oxygen, Oxygen, Acclimatization, Lethal limit, Oxygen requirements, Aquatic habitats, Resistance, On-site investigations, Aquatic animals, Mortality, Thermal pollution, Heat resistance, Heated water, Water temperatures.
Identifiers: Amphipods.

The crustaceans used were the isopod Asellus intermedius Forbes, and the amphipods Hyalella azteca (Saussure), Gammarus fasciatus Say, and Gammarus pseudolimnaeus Bousfield. Acclimation temperatures used before testing were 10 deg and 20 deg for all species, plus 30 deg for A. intermedius. Resistance to high temperature decreased with size in A. intermedius and G. fasciatus, over a weight-range of 1-35 mg. Small and medium-sized H. azteca were about equal in resistance. A rise in acclimation from 10 deg to 20 deg increased the temperature resisted for 24 hours by 1.9 deg in G. fasciatus, 1.3 deg in A. intermedius, and 0.5 deg in G. pseudolimnaeus, and apparently not at all in H. azteca. Estimates of the highest 24-hour lethal temperatures which could be obtained by raising acclimation were 34.6 deg for A. intermedius and G. fasciatus, 33.2 deg for H. azteca, and 29.6 deg for G. pseudolimnaeus. Differences in heat resistance between species are not as great as might be expected from their habitats. Temperature-resistance seems greater than necessary for survival in nature, especially for G. pseudolimnaeus, which is a cool-water species. Concentrations of oxygen causing 50% mortality in 24 hours were 0.03 mg/l for A. intermedius, 0.7 mg/l for H. azteca, 2.2 mg/l for G. pseudolimnaeus, and 4.3 mg/l for G. fasciatus. These oxygen values were for acclimation and testing at 20 deg, and changed for other combinations of temperatures. Resistance to low oxygen fits field observations fairly closely, and explains presence or absence of these species in polluted waters. (Speakman-Vanderbilt)
W70-07308

BODY CONDITION, WATER TEMPERATURE, AND OVER-WINTER SURVIVAL OF HATCHERY-REARED TROUT IN CONVICT CREEK, CALIFORNIA,
Bureau of Sport Fisheries and Wildlife, Bishop, Calif.
Norman Reimers.
Transactions of the American Fisheries Society, Vol 92, No 1, p 39-46, 1963. 1 fig, 3 tab, 14 ref.

Descriptors: Fish, *Rainbow trout, Trout, Fish hatcheries, *Fish management, *Fish stocking, *Overwintering sites, *Mortality, *Temperature, Spring, Fish behavior, Depreciation, Fish physiology, Water temperature, Fish establishment, California.
Identifiers: Convict Creek (California).

Summer stocked, catchable-sized, hatchery-reared rainbow trout (Salmo gairdneri) undergoing survival tests in controlled sections of a mountain stream repeatedly declined in condition (defined as weight in grams times 100,000 divided by the third power of the total length in millimeters) for several months after being stocked. In the spring months, when day length steadily increased and temperatures rose, spring recovery of trout vitality was expected. However, continuing mortality of the hatchery-reared trout suggested that they had depreciated since the previous summer to the extent that they responded adversely by depreciating further as the result of greater activity in the warming water. However, fall-stocked, hatchery-reared fish showed no appreciable rise in mortality until May, and three-fourths of the deaths recorded in that month were of fish stocked in August. Artificial selection of superior survivors for experimental breeding could be a useful step toward development of trout that are hardier in the wild. (Speakman-Vanderbilt)
W70-07309

SUPERSATURATION OF LAKE WATER WITH A PRECAUTION TO HATCHERY USAGE,
Toronto Univ. (Ontario). Dept. of Zoology.
Harold H. Harvey.
Transactions of the American Fisheries Society, Vol 96, No 2, p 194-201, 1967. 6 fig, 20 ref.

Descriptors: *Nitrogen, *Supersaturation, *Thermocline, *Hydrostatic pressure, Oxygen, Fish hatcheries, Lethal limit, Temperature, Dissolved oxygen.

Water temperature and dissolved oxygen were measured vertically in Cultus Lake on 20 occasions and dissolved nitrogen eight times during 1961. The results showed the water in the region of the thermocline became supersaturated markedly as a consequence of warming during the spring and summer. The excess gas was below the extent of surface mixing and was held in solution by the hydrostatic pressure. In mid-July, at a depth of 30 feet, oxygen was 126% and nitrogen 116% of air saturation. By mid-September at a depth of 50 feet, oxygen saturation was 94% and nitrogen 110% of air saturation. Oxygen was liberated by photosynthesis in the epilimnion and upper portion of the thermocline, and consumed in the lower part of the thermocline and the upper hypolimnion. Thus, nitrogen supersaturation could not be diagnosed by measurement of dissolved oxygen alone. Nitrogen supersaturation as low as 106% has been demonstrated to be injurious and lethal to fish. Thermocline water pumped to a hatchery will increase in nitrogen supersaturation with increased temperature. Use of thermocline water may be avoided by mixing epilimnion and hypolimnion waters to obtain the desired temperature. (Speakman-Vanderbilt)
W70-07310

DESTRUCTION OF FISHES AND OTHER ORGANISMS ON THE SOUTH TEXAS COAST BY THE COLD WAVE OF JANUARY 28 - FEBRUARY 3, 1951,
Texas Univ., Port Aransas. Inst. of Marine Science.
Gordon Gunter, and H. H. Hildebrand.
Ecology, Vol 32, p 731-736, 1951. 1 fig, 10 ref.

Descriptors: *Weather, *Cooling, *Fishkill, *Bays, Temperature, Mortality, Texas, Coastal areas, Acclimatization, Ecology, Thermal effects, Aquatic life.
Identifiers: Cold waves, Northers, Cold weather, Cold water.

The shallowness of Texas bay waters, their practically landlocked condition, and the rapidity with which cold northers strike the coast, are factors making the marine life of this area particularly subject to mortality from cold waves every few years. Since 1940, slight mortality was caused by cold waves in 1941 and 1949. Considerable damage was caused in 1947. The 1940 and 1951 episodes were catastrophic. Probably the 1940 instance was the most severe although the 1951 freeze was the hardest. Estimates made by biologists of the Game, Fish, and Oyster Commission of the amount of fish killed in 1951 range from 60 million to 90 million pounds. If the damaging cold waves are preceded by other freezes, their destructive effect is lessened. Some animals escape to deeper water if the onset of the cold wave is slow, and the rapidity with which the northers strike is a factor influencing the amount of mortality. (Speakman-Vanderbilt)
W70-07311

EFFECT OF TEMPERATURE AND PHOTOPERIOD ON THE SERUM PROTEINS OF THE RAINBOW TROUT, SALMO GAIRDNGRI,
Alberta Univ., Edmonton. Dept. of Zoology.
Herman M. Meisner, and C. P. Hickman, Jr.
Canadian Journal of Zoology, Vol 40, No 2, p 127-130, 1962. 1 tab, 14 ref.

Descriptors: *Temperature, *Rainbow trout, Acclimatization, *Proteins, Age, Sexual maturity, Fish physiology, Trout light.
Identifiers: Serum proteins, Photoperiod, Albumin, Globulin, Albumin globulin ratio.

The serum of 1- and 2-year-old Rainbow Trout, acclimatized at least 43 days to four conditions of temperature and daylength, was examined by paper electrophoresis. The albumin/globulin ratio was significantly greater in trout acclimated to 8 deg C than in those acclimated to 16 deg C. Photoperiod had no significant effect on the serum protein pattern. No effect of age or sex on serum proteins of fish kept under the same experimental condition was revealed. (Speakman-Vanderbilt)
W70-07312

EFFECTS OF INCREASED TEMPERATURES ON AQUATIC ORGANISMS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
John Cairns, Jr.
Proceedings of the 10th Industrial Waste Conference, Purdue University, Engineering Bulletin, Vol. 40, No. 1, 1956. p 346, 4 fig, 3 ref.

Descriptors: *Microorganisms, *Algae, *Dominant organisms, *Acclimatization, Diatoms, Thermal pollution, Temperature, Chemical properties, Ecology, Ecological distribution, Thermal effects.
Identifiers: Green algae, Blue-green algae, Heat death.

The population of microorganisms of a river is composed of the species that are best fitted to the local ecological conditions. Because there is a fierce competition for space, a species may be eliminated by an unfavorable, rather than lethal, factor, such as increased temperature. A mixed population of algae was taken from a normal healthy stream and gradually exposed to an increased temperature. At 20 deg C, a large number of species of diatoms were present and dominated the cultures. At 30 deg C, only two species of diatoms were numerous. Above 30 deg C, a few individual diatoms survived, but green algae predominated at 30 deg C to 35 deg C. In the range of 35 deg C to 40 deg C, blue-green algae were dominant. There are strong indications that the composition of the water is an important factor in heat death of aquatic organisms, since the chemical balance is usually quite different in heated waters from that of a typical stream. Microorganisms can be acclimatized to very high temperatures if the changes are small and gradual. (Speakman-Vanderbilt)
W70-07313

THE EFFECTS OF SUB-LETHAL LEVELS OF ZINC AND OF HIGH TEMPERATURE UPON THE TOXICITY OF A DETERGENT TO THE SUNFISH, LEPOMIS GIBBOSUS,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
John Cairns, Jr., and Arthur Scheier.
Notulae Naturae, No 367 p 1-3 June 26, 1964. 3 p, 5 ref.

Descriptors: *Sunfishes, *Temperature, *Alkyl benzene sulfonates, Fish, *Detergents, *Toxicity, Thermal effects, Thermal pollution.
Identifiers: Zinc, Sub-lethal effects, Synergism.

Sunfish were exposed to alkyl benzene sulfonate detergent for 30 days at a concentration sufficient to cause marked gill damage. The fish were then exposed to both zinc chloride and increased temperature in separate tests. The exposure to alkyl benzene sulfonate does not cause a gross change in the tolerance of the fish to either zinc ions or increased temperature. No duplication of experiments was conducted. (Speakman-Vanderbilt)
W70-07314

EFFECTS OF THERMAL FLUCTUATIONS ON THE RELATIVE SURVIVAL OF GREENTHROAT DARTER YOUNG FROM STENOTHERMAL AND EURYTHERMAL WATERS,
Texas Univ., Austin. Dept. of Zoology.
Clark Hubbs.
Ecology, Vol 45, No 2, p. 376-379, 1964. 1 tab, 11 ref.

Descriptors: Spring waters, *Fish, *Darters, *Temperature, *Variability, *Thermal springs, Springs, Thermal effects, Thermal waters.
Identifiers: Adaptation, Stenothermal environment, Eurythermal environment, Thermal shock, Temperature fluctuations.

Adaptation of a stenothermal spring population of greenthroat darter young to thermal fluctuations is compared experimentally with that of eurythermal stream populations of the same species. Experiments were carried out on zygotes derived from gametes removed from wild-caught parents and the resulting developmental stages from egg development through late larvae. Results showed increased resistance to thermal shock with increased temperature fluctuations. (Speakman-Vanderbilt)
W70-07315

THE INFLUENCE OF WEIGHT AND TEMPERATURE ON THE METABOLIC RATE OF SUNFISH,
State Univ. of New York, Albany. Dept. of Biological Sciences.
JamesO'Hara.
Ecology, Vol 49, No 1, p. 159-161, 1968. 1 fig, 1 tab, 9 ref.

Descriptors: *Oxygen requirements, Oxygen, *Metabolism, Temperature, *Weight, *Sunfishes, Aquatic animals, Aquatic environment, Animal physiology, Fish, Fish physiology.
Identifiers: Pumpkinseed, Bluegill, Adaptation.

Oxygen consumption was determined for sunfish between 1.4 and 116.0 grams at 25 deg C and 30 deg C. Metabolic rates of smaller fish are less affected by temperature change than those of large fish. Interspecific comparison indicates that bluegills (Lepomis macrochirus) are better adapted to higher temperatures than pumpkinseeds (L. gibbosus). (Speakman-Vanderbilt)
W70-07316

THERMAL POLLUTION--BIOLOGICAL EFFECTS,
Water Pollution Control Federation, Washington, D.C. Research Committee.
C. C. Coutant.
Journal of the Water Pollution Control Federation, Vol 41, No 6, p. 1036-1053, 1969. 111 Ref.

Descriptors: *Aquatic life, *Ecology, Metabolism, Heat resistance, *Thermal pollution, Thermal discharges, Temperature, Waste assimilative capacity, Productivity, Performance, Growth, Animal physiology, Cold resistance, Fish physiology, *Animal behavior, *Biology, Reproduction.

This review summarizes the results of the most recent research concerning the biological effects of thermal pollution. Subjects covered specifically include heated discharges, reviews of temperature effects, thermal resistance, temperature selection, primary production, and waste stabilization. Also covered are the effects of temperature on reproduction, performance, growth, learning (conditioned response), and physiological activities, as well as the synergistic effects of temperature and other pollutants. (Speakman-Vanderbilt)
W70-07317

FURTHER STUDIES OF DEPTH DISTRIBUTION OF FISH, NORRIS RESERVOIR, TENNESSEE,
Tennessee Valley Authority, Norris.
Jack S. Dendy.
Journal of the Tennessee Academy of Science, Vol. 21, p. 94-104, 1944. 4 fig, 5 tab, 9 ref.

Descriptors: *Temperature, *Depth, *Reservoir fisheries, *Distribution, *Fish behavior, *Ecological distribution, Fish, Tennessee, Gill nets, Reservoirs, Bass, Drums, Walleye, Sauger, Fisheries, Fish populations, Aquatic habitats, Thermal stratification.
Identifiers: Norris reservoir, Clinch River, Shad.

Four gill nets, each 8 feet high and approximately 200 feet long were placed in Norris Reservoir at right angles to the shoreline, with one end at the water's edge and the other in deep water. Records were kept of species and weight of fish and depth at which each was caught. Data from 1944 and 1943 netting studies were in close agreement. In both studies fish were caught in water which contained too little oxygen to support them for extended periods. Distribution according to depth did not compare between the two studies as closely as did distribution according to temperature. Thus, temperature is of more significance than depth in the distribution of fishes. In normal years a close enough correlation exists between temperature and fish distribution to permit prediction of summertime distribution by making temperature measurements. (Speakman-Vanderbilt)
W70-07318

A FIELD AND LABORATORY INVESTIGATION OF THE EFFECT OF HEATED EFFLUENTS ON FISH,
Ministry of Agriculture, Fisheries and Food, London (England).
J. S. Alabaster, and A. L. Downing.
Fisheries Investigations, Series I, Vol VI, No. 4, 1966. 42 p, 21 fig, 15 tab, 35 ref.

Descriptors: *Fish, *Thermal pollution, *Heated water, *Temperature, *Fishkill, *Environmental gradient, Thermal power, Thermal stratification, Seasonal, Water circulation, Stress, Mortality, Trout, Rough fish, Carp, Aquatic life, Aquatic environment, Acclimatization, Behavior, Ecology, Water temperature, Heat resistance, Thermal stress, Fish barriers.
Identifiers: Roach, Perch, Gudgeon, Tench, Temperature gradient, Britain.

Tests in the laboratory and in British cooling-water outlets themselves have demonstrated that the increase in temperature of the water used by electricity generating stations for cooling purposed during the summer was often potentially lethal to trout and to the more sensitive species of coarse fish, such as roach, perch, and gudgeon, though not to tench and carp. Coarse fish (but not trout) were present in nearly all the rivers receiving these heated discharges, yet they were rarely seen to be killed, even close to the effluent outfalls. It seems likely that the fish avoid lethal conditions since they can perceive very small differences in temperature and are capable of selecting temperatures when tested in a gradient. It seems likely that, in rivers receiving heated effluents, the tendency for the hottest water to remain at the surface allowed the fish to survive in the cooler water below. In an experimental channel, fish were able to respond to lateral gradients of temperature or to increases in temperature and so avoid lethal conditions. On the two occasions when uncaged fish were found dead, many of the fish apparently escaped successfully, the majority killed being small gudgeon. These were also found to be vulnerable to rapid temperature changes in the experimental channel. (Speakman-Vanderbilt)
W70-07320

THE EFFECT OF LOW DISSOLVED OXYGEN CONCENTRATIONS ON TEMPERATURE - SALINITY TOLERANCE OF THE SAND SHRIMP, CRANGON SEPTEMPINOSA SAY,
Maine Univ., Orono.
Paul A. Haefner, Jr.
Physiological Zoology, Vol. 43, No. 1, p 30-37, 1970. 2 tab, 4 fig, 23 ref.

Descriptors: *Shrimp, *Temperature, *Dissolved oxygen, Oxygen, Mortality, Environmental effects, Estuarine environment, Estuaries, Aquatic habitats, Water temperature, Aquatic animals, Pollution, Water Pollution, Water pollution effects.

Identifiers: Sand shrimp.

Male and female (ovigerous and nonovigerous) sand shrimp, Crangon septemspinosa, were subjected to 12 temperature-salinity combinations at dissolved oxygen concentrations of 2-3 parts per million. Mortality data from this design were used to fit response contours for estimating the influence of low oxygen tension on the temperature-salinity tolerance of the species. There existed no possible temperature-salinity combinations at which 100 per cent survival of the adult sand shrimp could occur at those low oxygen tensions. Low oxygen tensions tend to shift the mortality contours toward lower temperatures and higher salinities, compared to those in aerated water. Female shrimp are more sensitive to low oxygen concentrations than are males, and berried females are most susceptable of the groups. Within an estuarine zone, any seaward or offshore migration to cooler, more saline water would be of survival value to the species. (Speakman-Vanderbilt)
W70-07321

THE EFFECTS OF BENTHAL DEPOSITS ON THE OXYGEN RESOURCES OF NATURAL STREAMS,
New York Univ., N.Y. Dept. of Civil Engineering.
Joseph A. Ogunrombi, and William E. Dobbins.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 538-552, April 1970. 15 p, 12 fig, 4 tab, 7 ref.

Descriptors: *Bottom sediments, *Sludge, *Decomposing organic matter, *Oxygen demand, *Dissolved oxygen, Water pollution effects, Biochemical oxygen demand.
Identifiers: Bottom sludge decomposition.

Two distinct processes taking place in benthal decomposition were investigated. These processes are: (a) The addition of organic material from the benthal deposits to the overlying water. This material then is carried downstream as part of the flowing biochemical oxygen demand load. (b) The removal of dissolved oxygen from the overlying water to satisfy the oxygen demands of benthal deposits at the aerobic top layer, and the immediate demands of the end-products of anaerobic decomposition. Mathematical expressions were developed for evaluating the magnitude of the rates by which the processes are measured. Laboratory experiments were conducted in continuous flow, completely mixed reactors. (Knapp-USGS)
W70-07349

TOXICOLOGICAL ASPECTS OF WASTEWATER RECLAMATION--A PRELIMINARY REPORT,
California State Dept. of Public Health, Berkeley. Sanitation and Radiation Lab.
Alice Ottoboni, and Arnold E. Greenberg.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 493-499, April 1970. 7 p, 2 fig, 2 tab, 18 ref.

Descriptors: *Water pollution effects, *Water reuse, *Toxicity, *Reclaimed water, Waste water (Pollution), Sewage effluents, Pathology, Public health, Safety.
Identifiers: Wastewater safety.

Research on the toxicity of domestic wastewater to rats was conducted. Domestic waste water (unchlorinated activated sludge plant effluent) was provided as the sole water source to a group of young rats and the same community's potable water supply was given to a second, or control, group. Male rats in the experimental group gained more weight than control males; female rats given waste water had smaller adrenal glands than control females; and two male test rats developed massive tumors not seen previously in the rat strain at such a young age in the 18-wk test. (Knapp-USGS)
W70-07350

AQUATIC BIOLOGY ABSTRACTS, 1969.
For primary bibliographic entry see Field 10.
W70-07370

PROCEEDINGS FLORIDA'S ENVIRONMENTAL ENGINEERING CONFERENCE ON WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 05G.
W70-07371

RESEARCH TO SAVE AMERICA'S LAKES,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
Thomas E. Maloney, and Alfred F. Bartsch.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 278-280, 1969. 3 p.

Descriptors: *Eutrophication, *Lakes, *Water pollution control, *Reviews, Algae, Weeds, Ecology, Environment, Chemcontrol, Biocontrol, Integrated control measures, Physical control, Water quality.
Identifiers: *Eutrophication control.

The maturation process of a lake is called eutrophication and is greatly accelerated by man's activities which increase the nutrient input to the lake. These activities include agricultural development, urbanization, and the discharge of sewage, industrial waste, and treatment plant effluents to the lakes. With advancing of eutrophication, symptoms appear including: an increase in productivity of algae, waterweeds, and other living matter; the nitrogen and phosphorus concentrations increase; dissolved oxygen is depleted in the lower depths; the more desirable fish species become extinct, and rough fish species appear; and rooted vegetation begins to grow in from the lake margin and eventually fills the lake. (See also W70-07380). (Knapp-USGS)
W70-07393

CHRONIC EXPOSURE OF BLUE CRABS, CALLINECTES SAPIDUS, TO SUBLETHAL CONCENTRATIONS OF DDT,
Bureau of Commercial Fisheries, Gulf Breeze, Fla. Biological Lab.
Jack I. Lowe.
Ecology, Vol 46, No. 6, 1965, 1 tab, 4 ref.

Descriptors: *DDT, *Bioassay, Crabs, Water pollution effects, Chlorinated hydrocarbon pesticides, *Pesticide toxicity, *Growth rates.
Identifiers: Blue crabs, *Callinectes sapidus, Chronic exposure tests, *Molting changes.

Juvenile blue crabs, Callinectes, sapidus, were reared for 9 months in flowing sea water containing sublethal concentrations of DDT. Six were used as controls and 6 each were placed in .25 and .50 ppb DDT. Crabs fed, molted, and grew for 9 months in sea water containing 0.25 ppb (micrograms/liter) DDT but could survive only a few days in water containing DDT in excess of 0.5 ppb. (Sjolseth and Katz-Washington)
W70-07406

EFFECTS OF LAMPREY LARVICIDES ON INVERTEBRATES IN STREAMS,
Bureau of Commercial Fisheries, Marquette, Mich. Fisheries Biological Station.
Richard L. Torblaa.
U. S. Fish and Wildlife Service, Special Scientific Report-Fisheries No. 572, August, 1968. 13 p, 11 tab, 2 fig, 11 ref.

Descriptors: *Great Lakes, Lake Superior, Lake Michigan, Benthic fauna, Aquatic animals, *Aquatic populations, *Larvicides, *Lampreys, On-site data collections, *Invertebrates, *Aquatic insects, Resistance mortality.
Identifiers: Petromyzon marinus, *TFM, *Bay luscide, *Recovery, *Population changes.

The study was conducted on five streams tributary to Lake Superior and four tributary to Lake Michigan. Samples of the bottom fauna before and after chemical treatment revealed that most groups of aquatic organisms were not adversely affected by exposure to the lamprey larvicides TFM and Bay luscide. The total number of invertebrates was smaller 1 week after treatment than before treatment, increased somewhat by 6 weeks after treatment, and had returned to pretreatment levels 1 year after treatment. Aquatic insects were affected less than other organisms, and invertebrates were more severely affected and recovered more slowly in areas of sand and detritus than in riffle areas. (Sjolseth and Katz-Washington)
W70-07407

CONTROL OF APUS AND FAIRY SHRIMP IN HATCHERY REARING PONDS,
National Fish Hatchery, Tishomingo, Okla.
Russell G. Hornbeck, Warren White, and Fred P. Meyer.
Proceedings of the 19th Annual Meeting of the Southeastern Association of Game and Fish Commissioners, Tulsa, Oklahoma, October 10-13, 1965. p 401-404, 1 tab, 1 ref.

Descriptors: Channel catfish, Pest control, *Fish management, *Fish hatcheries, Bass, Turbidity, Growth rates, Shrimp, Chlorinated hydrocarbon pesticides, Toxicity, Bioassay, *Rotenone, Resistance, Water pollution effects, Plankton.
Identifiers: *Dylox, *Apus longicaudatus, *Streptocephalus texanus, Tishomingo, Oklahoma, *Fish production, Fairy shrimp, Parathion.

Single applications of 0.25 ppm Dylox effectively controlled the tadpole shrimp, Apus longicaudatus, in hatchery ponds without adverse effects on bass or channel catfish fry. Bass survival in treated ponds was boosted from 20 to 80 per cent by the Dylox treatment. Plankton populations in the treated ponds appeared unaffected. (Sjolseth-Washington)
W70-07408

EFFECTS OF POLLUTION ON ESTUARINE ECOSYSTEMS: I. EFFECTS OF EFFLUENTS FROM WOOD-PROCESSING INDUSTRIES ON THE HYDROGRAPHY, BOTTOM AND FAUNA OF SALTKALLEFJORD (W. SWEDEN),
Institute of Marine Research, Helsinki (Finland).
Pauli Bagge.
Merentutkimuslaitoksen Julkaisu/Havsforskningsinstitutets Skr. No. 228, p 3-118, 1969. 23 tab, 28 fig, 135 ref.

Descriptors: *Water pollution effects, Water pollution sources, *Estuarine environment, *Pulp wastes, Pulp and paper industry, *Sulfite liquors, Hydrography, *Benthic fauna, On-site investigations, Hydrogen ion concentration, *Water quality, Bioindicators, Biochemical oxygen demand, Bottom sediments, Chemical oxygen demand, Turbidity, Limnology, Benthic flora.
Identifiers: Saltkallefjord, Sweden, SWL, Littoral fauna, *Community distribution, *Animal diversity, *Estuarine ecosystems.

Saltkallefjord, Sweden has received effluents from a sulphite pulp and paper mill over a period of more than 80 years. In 1964 the discharge of effluents from factories into the fjord amounted to about 60,000 M3 per day. The main part of the wastes consisted of sulphite waste liquor (SWL), but the effluent contained also particulate material. Sewage was also discharged into the fjord. SWL was found to interfere with the pH, oxygen content, chemical and biochemical oxygen demand and transparency of the water. The influence of the effluents was revealed by (1) an increase in the organic content and bacterial activity in water and sediment (indicated by high BOD values), (2) a decline in the littoral fauna and vegetation, (3) low and fluctuating oxygen values, (4) macrofaunal communities differing from those reported in earlier investigations of the area, (5) high numbers of saprobic ciliates on heavily polluted bottoms, and (6), the predominance of limivorous (non-selective deposit feeding) deep-burrowing species in polluted localities. The selective effect of pollution on

the fauna was evident in both qualitative and quantitative changes, the distribution of the communities and the decreased diversity of the fauna in polluted areas. (See also W70-07410). (Sjolseth-Washington)
W70-07409

EFFECTS OF POLLUTION ON ESTUARINE ECOSYSTEMS: II. THE SUCCESSION OF THE BOTTOM FAUNA COMMUNITIES IN POLLUTED ESTUARINE HABITATS IN THE BALTIC-SKAGERAK REGION,
Institute of Marine Research, Helsinki (Finland).
Pauli Bagge.
Merentutkimuslaitoksen Julk/Havsforskningsinstitutets Skrift No. 228, p 119-130, 1969. 5 fig, 2 tab, 15 ref.

Descriptors: *Water pollution effects, Water pollution sources, Estuarine environment, *Benthic fauna, *Succession, *Bioindicators, Salinity, Oligochaetes, Climatic climax, Biological communities, Limnology, Pulp wastes.
Identifiers: *Estuarine ecosystems, *Macrofaunal communities, *Baltic Sea, *Skagerak, Sweden, Secondary succession, Climax communities, *Estuarine pollution, Polychaetes, Salinity zones.

The macrofaunal communities of five polluted estuaries situated in the Baltic--Skagerak region and representing different salinity ranges are compared. The secondary succession of the animal communities caused by pollution reveals to be a rapid process, especially in localities where the exchange of water is limited by sills, ice-cover or retarded estuarine circulation. The use of aquatic organisms and communities as indicators of clean water and various degrees of pollution is discussed. (See also W70-07409). (Sjolseth-Washington)
W70-07410

INTERNATIONAL CONFERENCE ON OIL POLLUTION OF THE SEA.

Report of Proceedings, held 7-9 October 1968 at Rome, Italy. Wykeham Press, Winchester, Great Britain, (1969). 414 p, append.

Descriptors: *Oil waste, *Oil-water interfaces, *Water pollution effects, *Water pollution control, *Internation Commissions, *International law, *Oceans, Oily water, Water pollution sources, Water pollution treatment, Legislation, International waters, Law of sea, Oceanography, Coasts.
Identifiers: *Oil pollution, *Coastal pollution, Oil spills, *Clean seas code.

This is the Third International Conference on Oil Pollution of the Sea: the first was held in London in 1953 and the second in Copenhagen in 1959. Individual papers were presented on the biological effects of oil pollution in the ocean and coastal waters, means of measuring and detecting oil pollution, and national and international control of oil pollution by technical and legal endeavors. The Clean Seas Code is suggested as a legal and practical means for achieving operational control of oil pollution in the sea. Eight resolutions are adopted and recommended in the appendix. (See also W70-07412 thru W70-07420).
W70-07411

THE IMPACT OF OIL POLLUTION ON SEA BIRDS IN EUROPE,
Rijksinstituut voor Veldbiologisch Onderzoek ten Behoeve van het Natuurbehoud, Zeist (Netherlands).
J. J. C. Tanis, and M. F. Morzer Bruyns.
International Conference on Pollution of the Sea, Rome, p. 67-74, Oct. 7-9, 1968.

Descriptors: Water pollution, Oil, *Water birds, Sea water, On-site investigations, *Water pollution effects, *Oily water, Oil wastes, Toxicity, Mortality.
Identifiers: North Sea, Baltic Sea, *Oil production.

Oiled birds are indicators of oil pollution of the sea. This paper deals with systematic surveilance made in several European countries from 1958-1968. Increasing pollution was noted along the North Sea and Baltic Sea coasts, especially in the autumn and early winter. The Mediterranean Sea had a constant but seldom concentrated pollution. Quantitative data for the Dutch-Belgian coast provided a monthly average number of victims per kilometer of 3.8 in 1962-1968 as compared with 1.9 in 1958-1962. The Common Scoter was the most stricken species. The actual number of birds that perish from oil pollution is much greater than the number reaching shore, possibly by a factor of 6-25. The regular occurrence of pollution has little effect on most bird groups, but if an important breeding, moulting, migration, or wintering area where the population of a particular species is concentrated is threatened by extensive oil pollution as from shipping disasters, the result could be quite different. A map giving a relative measure of oil pollution of European coastal areas for 1960-1968 is included. (See also W70-07411). (Harbert-Washington)
W70-07412

OIL POLLUTION AND THE CONSERVATION OF SEABIRDS,
Newcastle-upon-Tyne Univ. (England). Dove Marine Lab.
R. B. Clark.
International Conference on Oil Pollution of the Sea, Rome, p 76-112, October 7-9, 1968. 134 refs.

Descriptors: *Water birds, *Water pollution effects, Oil wastes, *Oily water, Sea water, mortality, Water pollution sources, Ducks, Rehabilitation, Animal diseases.
Identifiers: Oil tankers, Common guillemots, Brunnich's guillemots, Razorbills, Puffins, Long-tailed ducks, Eidel ducks, Common scoters, Oil pollution, *Biological effects, Torrey-Canyon, Long-term effects.

Spectacular disasters like the 'Torrey-Canyon' wreck cause the death of many seabirds, but chronic oil pollution of the sea is possibly more serious. Results to bird populations by both of these causes of mortality are reviewed and estimates of declines in certain populations are given. The immediate and long-term effects of oil contamination to seabird populations, especially to the auks which are the most seriously affected group of birds, are discussed in terms of replacement rates, egg laying and incubation, loss of waterproofing of the plumage, and loss of food organisms. The effects and subsequent rehabilitation of emaciation, lowering of body temperature, ingestion of oil, stress, and oil on plumage which are all caused by oiling are detailed. The feeding of, care of, and diseases acquired by birds while in captivity are mentioned as well as their subsequent return to the natural population. Rehabilitation has been relatively unsuccessful, and therefore, conservation of the most vulnerable species of seabirds is urged. (See also W70-07411) (Harbert-Washington)
W70-07413

BIOLOGICAL ASPECTS OF OIL POLLUTION,
Yamashina Inst. for Ornithology and Zoology, Tokyo (Japan).
Y. Yamashina.
International Conference on Oil Pollution of the Sea, Rome, p 112-114, October 7-9, 1968.

Descriptors: Water pollution, Sea water, Oil wastes, *Oily water, Water birds, Japan, *Water pollution effects, Emulsifiers, Waste disposal, Waste treatment, Water pollution control, *Mortality.
Identifiers: Guillemots, Sea green, Oil pollution.

The first marked damage in the seas around Japan by oil pollution was in 1954 to hatcheries. Oil pollution has increased since with increasing use of oil. In 1967, the Japanese Government ratified the international convention for prevention of pollution of the sea by oil proposed in 1954 and amended in 1962. Five cases of oil pollution by tankers occurred between October 1967 and June 1968. Two cases of oil pollution by earthquake and tidal wave damage occurred during 1968, but all were of small extent and were dispersed by spreading Seagreen, an emulsifier. The government has helped finance the construction of equipment for the disposal of waste oil at ports of Japan and the aquisition of guard boats to locate floating oil. Only one case of extensive damage to sea birds has been documented in Japan in which about 1,400 sea birds, chiefly guillemots, were washed ashore. (See also W70-07411) (Harbert-Washington)
W70-07414

OILING OF MARINE BIRDS IN SOUTH AFRICA,
Cape Town Univ. (South Africa).
M. K. Rowan.
International Conference on Oil Pollution of the Sea, Rome, p. 121-124, Oct. 7-9, 1968.

Descriptors: Sea water, *Water birds, Oily water, Diets, *Rehabilitation, Salmonella, Water pollution effects, *Mortality.
Identifiers: South Africa, *Jackass Penguin, Cormorant, Cape Gannet, Fuller's earth, *Oil pollution, Malnutrition.

Recent oil pollution along South Africa has not had noticeable effects upon inshore or highly pelagic feeders, but has resulted in extensive oiling of birds of the intermediate zones such as Cormorants, Cape Gannets, and Jackass Penguins. The first report of substantial numbers of oiled penquins was in April 1968. Between June and August, 1,7000 affected penquins were collected of which 400 died or were killed prior to treatment, and at least 350 died after treatment. Soaps, detergents, and sulphonated caster oil were found to have deleterious effects, whereas Fuller's earth was found to clean the birds with good success. Proper feeding is important. Oily fish such as pilchards produced good weight gains. Causes of mortality during treatment included malnutrition, fungal infections of the respiratory tract, and Salmonella infection. Captured penguins formed groups and release in such groups was thought to increase survival. (See also W70-07411) (Harbert-Washington)
W70-07415

THE SCIENTIFIC APPROACH TO THE PROBLEM OF OIL POLLUTION,
Solly Zuckerman.
International Conference on Oil Pollution of the Sea, Rome, p 148-159, Oct 7-9, 1968. 5 refs, 1 fig.

Descriptors: *Water pollution control, Oil wastes, *Oily water, Detergents, Water pollution effects, Water pollution treatment, Treatment, Methodology, Future planning, Safety factors.
Identifiers: *Oil spills, Torrey-Canyon, Oil pollution, *Safety precautions.

Many things were learned from the 'Torrey-Canyon' accident. Along with a diagram of the interrelationships of various chains of events which can follow major oil spills is a discussion of some of the lessons that were learned and the research being done as a result. This paper discusses the coordination of the attack upon the spillage, the importance of the location, methods for dealing with large spills, including mechanical containment and recovery, chemical dispersion, and sinking and burning the oil, measures for combatting coastal pollution, the enduring effects of oil pollution including its effects upon marine life and the effects of natural factors on the movement, dispersal, and destruction of oil at sea, the scale of effort, and the importance of prevention. (See also W70-07411) (Harbert-Washington)
W70-07416

DISPERSAL OF OIL SLICKS IN PORTS AND AT SEA,
Standard Oil Company of New Jersey.
Thomas W. Moore.

International Conference on Oil Pollution of the Sea, Rome, p 234-239, Oct 7-9, 1968.

Descriptors: Water pollution control, Oil wastes, Oily water, Surfactants, Dispersion, Detergents, Water pollution treatment, Methodology.
Identifiers: Corexit 7664, Oil pollution, Oil spills.

When an oil slick occurs it is preferable to remove the oil by mechanical means, but this is not always possible, and a new surfactant, Corexit 7664, has been developed as an effective dispersant which is non-toxic to marine life. Corexit can be sprayed onto an oil slick from boats, planes, or helicopters and has been highly effective with a wide variety of whole crudes and distilled petroleum fractions. It is of limited value with residuals and fractions with high viscosities. After being sprayed, either natural or induced agitation of the water surface is necessary. Then the oil is broken up into dispersed droplets encapsulated with Corexit and becomes a relatively stable oil-in-water dispersion. It is biodegradable and has been proven to be non-toxic to tropical fish and shrimp at 10,000 ppm for 24 hours. (See also W70-07411) (Harbert-Washington)
W70-07417

OIL POLLUTION IN SOUTH AFRICA,
G. H. Stander, and J. A. V. Venter.
International Conference on Oil Pollution of the Sea, Rome, p 251-259. 1968.

Descriptors: *Water pollution effects. Oil wastes, *Oily water, Detergents, *Water pollution control, Legislation, Mortality, Water pollution treatment.
Identifiers: *South Africa, *Oil pollution, Suez Canal, *Biological effects.

The closure of the Suez Canal has greatly increased the oil tanker traffic around South Africa. Accidents involving oil spillage during 1968 are reported. Examination of the polluted areas revealed bird mortalities, and in one case, a high mortality of sand hoppers, but little damage to other marine life. The cleansing of polluted areas by detergent is discussed. Tests in South Africa on various detergents showed all to be approximately the same order of toxicity. There are two main objectives in the formation of legislation, procurement of the powers to cope with willful or accidental spillage and the prevention of oil pollution, on which the South African government is working. (See also W70-07411) (Harbert-Washington)
W70-07419

THE POLLUTION OF SEA WATER BY DETERGENTS AS A CONTRIBUTORY CAUSE OF DELETERIOUS EFFECTS ON TYRRHENIAN PINE WOODS,
Pisa Univ. (Italy).
P. L. Lapucci.
International Conference on Oil Pollution of the Sea, Rome, p 381-388, Oct 7-9, 1968. 2 tab, 8 ref.

Descriptors: *Water pollution sources, Detergents, Chlorides, *Boron, Foaming, *Pine trees, Water pollution effects, Air pollution effects, Beach erosion, Domestic wastes.
Identifiers: *Tyrrhenian coast, *Anionic detergents.

Widespread and increasing deterioration of pine woods along the Tyrrhenian coasts of Italy has occurred in recent decades. Invariably, the pines closest to the sea have been the first to die. Detergents discharged into the sea from sewers and drains may play an important part since anionic detergents which don't decompose form a fine and persistent film on the sea surface and favor the absorption of other substances, such as oil, chlorides, and boron. During heavy sea swells in shallow areas, these detergents form foams which are blown onto the leaves of trees. (See also W70-07411) (Harbert-Washington)
W70-07420

VERTICAL MIGRATION OF ZOOPLANKTON IN WESTERN LAKE SUPERIOR,
Minnesota Univ., Duluth.
Wayland R. Swain, Richard W. Magnuson, Jack D. Johnson, Theodore A. Olson, and Theren O. Odlaug.
Available from the Clearinghouse as PB-192313, $3.00 in paper copy, $0.65 in microfiche. Report (1970). 57 p, 2 tab, 18 fig, 26 ref. OWRR Project A-022-MINN (1).

Descriptors: *Zooplankton, *Vertical migration, *Diumal distribution, Minnesota, Migration patterns, Distribution, Density stratification.
Identifiers: *Lake Superior, Planton indicators, Density distribution.

During the years of 1967, 1968, and 1969, studies were directed toward the vertical distribution of some of the principal zooplankters in Western Lake Superior. These analyses were based on sequential samples taken by means of the Hardy Plankton Indicator, an instrument developed for oceanographic work by the Scottish Marine Biological Association of Edinburgh, Scotland. Zooplankters were taken at regular intervals between one and forty meters of depth. In all instances, samples were taken on a twenty-four hour basis to include both periods of daylight and darkness. Organisms were filtered onto Number 60 Swiss Silk Grit Gauze (60 mesh per inch). Zooplankton collections were made on two principal routes; transect runs of 7.2 miles each direction from Knife River, Minnesota, to Two Harbors, Minnesota, and back again; and an equilateral triangular course of two and one-half miles in length in a fixed area. Significant differences were noted in the diurnal variations throughout the water mass. Highest concentrations in the surface samples were noted during the nighttime hours. Interesting shifts of density distribution were apparent throughout each of the years studied. Available data is correlated with existing thermal and light regime information.
W70-07510

THE CHARACTERISTICS AND POLLUTIONAL PROBLEMS ASSOCIATED WITH PETROCHEMICAL WASTES, SUMMARY REPORT,
Engineering-Science, Inc. Texas, Austin.
For primary bibliographic entry see Field 05D.
W70-07511

A CONTINUOUS RECIRCULATING CULTURE SYSTEM FOR PLANKTONIC COPEPODS,
National Marine Water Quality Lab., Kingston, R.I.
E. J. Zillioux.
Marine Biology, International Journal on Life in Oceans and Coastal Waters, Vol 4, No 3, p 215-218, November 1969. 1 tab, 1 fig, 16 ref. FWPCA Project 18050 OUC.

Descriptors: *Plankton, *Copepods, *Culture control, Cultures.
Identifiers: Acartia clausi, Acartia tonsa, Seawater (Synthetic), Culture (Continuous), *Culture (Copepod), Copepod (Feeding).

The calanoid copepods, Acartia clausi Giesbrecht and Acartia tonsa Dana, are maintained at high densities in continuous culture at 15 deg C. Synthetic sea-water medium is recirculated through filters and a foam tower which limits accumulation of dissolved wastes and various metabolites. The ciliate Euplotes vannus Muller is associated in culture with the copepods, and effectively controls bacterial population and accumulation of algal debris. The copepods graze upon the ciliates as well as upon the phytoflagellates Isochrysis galbana Parke and Rhodomonas baltica Korsten.
W70-07518

RESPONSES OF SOME ANADROMOUS FISHES TO VARIED OXYGEN CONCENTRATIONS AND INCREASED TEMPERATURES,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Donald Dorfman, and James Westman.
Available from the Clearinghouse as PB-192 312, $3.00 in paper copy, $0.65 in microfiche. Rutgers University, Water Resources Research Institute, Partial completion and termination report, June 1970. 75 p, 15 tab, 61 ref. OWRR Project B-012-NJ (1).

Descriptors: *Ecology, *Environmental effects, *Fish, *Dissolved oxygen, *Thermal pollution, Water quality, Growth rates.
Identifiers: *Anadromous fish, Thermal limits, Delaware River, American shad, Striped bass.

Striped bass, Roccus saxatilis, while perch, Roccus americanus, American shad, Alosa sapidissima, blueback herring, Alosa aestivalis, and alewives, Alosa pseudoharengus, were studied to determine their survial, responses and growth in reduced concentrations of dissolved oxygen. The upper thermal limits and tolerances were also determined for striped bass, white perch and alewives. Diurnal concentrations of dissolved oxygen were provided at levels similar to those occurring in the Philadelphia - Camden region of the Delaware River. Special tanks were constructed for establishing gradients of dissolved oxygen.
W70-07523

BENTHAL DECOMPOSITION OF ADSORBED OIL POLLUTANTS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
J. V. Hunter, H. L. Allen, and T. B. Shelton.
Water Resources Research Institute, Rutgers - The State University of New Jersey, May 1970. 31 p, 14 fig.

Descriptors: *Oil wastes, *Sludge, *Biochemical Oxygen Demand, Oil, Petroleum, Adsorption, Water pollution.
Identifiers: *Benthal oxygen demand.

The hydrocarbons found in motor oil and n-octadecane are degradable in a benthal deposit under aerobic conditions. The average rate of benthal oxygen demand observed, using acclimatized seed, was 5 gms/m2/day. The maximum observed rate of BOD exertion for adsorbed octadecane, with acclimatized seed, was, approximately, 0.085 mg O2/mg octadecane/day. The rate of benthal uptake is affected by the substrate concentration, the rate of water passage, and, initially, by the seed concentration. Sludge depth has no effect on the uptake rate. The effect of D.O. level is related to, but less significant than, the effect of water passage rate. The results suggest that much of the behavior of the adsorbed substrate type of deposit may be ascribed to the physical nature and especially to the surface, or interfacial, characteristics of the deposit itself. (Hunter-Rutgers)
W70-07528

TOXICOLOGY OF THIODAN IN SEVERAL FISH AND AQUATIC INVERTEBRATES,
Bureau of Sport Fisheries and Wildlife, La Crosse, Wis. Fish Control Lab.
Richard A. Schoettger.
Investigations in Fish Control, No 35, Jan 1970. 31 p, 16 tab, 2 fig, 62 ref.

Descriptors: *Chlorinated hydrocarbon pesticides, *Pesticide toxicity, *Bioassay, Pesticide residues, Fish control agents, Fishkill, Fish physiology, Rainbow trout, Mortality, Lethal limits, Daphnia, Animal metabolism, Carbon radioisotopes.
Identifiers: *Thiodan, Metabolic pathways, Toxicology, *Endosulfan, Hatching success, Goldfish.

Thiodan, a chlorinated hydrocarbon insecticide, was tested against rainbow trout and their fertilized eggs, western white suckers, Daphnia magna, and

damselfly naiads. The median tolerance limits for trout and suckers ranged between 0.3 and 8.1 ppb and the fish were at least seven times more susceptible than the invertebrates. Toxicity was influenced by temperature, length of exposure, and alkaline pH. Exposures for up to 2 hours to 50 ppm of Thiodan were not toxic to fertilized trout eggs. The deposition and metabolism of Theodan residues in western white suckers, northern creek chubs, and goldfish were traced with the aid of carbon-14 labeled Thiodan, and chemical analyses of Thiodan in tissues. Residues occurred in the skin and muscles of fish exposed to acute and to multiple subacute concentrations. The death of fish which were poisoned subacutely was correlated with size and the lipid content of muscle. (Sjolseth-Washington)
W70-07548

A COMPARISON OF THE TOXICITY OF SOME COMMON INDUSTRIAL WASTE COMPONENTS TESTED INDIVIDUALLY AND COMBINED,
Virginia Polytechnic Inst., Blacksburg.
John Cairns, Jr., and Arthur Scheier.
Progressive Fish-Culturist, Vol 30, No 1, p 3-8, January 1968. 3 tab, 8 refs. U.S. Public Health Service Grants RRG-3965 and EF-00266.

Descriptors: Water pollution effects, *Bioassay, *Toxicity, Mortality, Industrial wastes, *Sunfishes, *Copper, Lethal limit, Potassium compounds.
Identifiers: *Synergism, *Antagonistic interaction, Lepomis macrochirus, *Acetaldehyde, *Acetic acid, *Acetone, *Cyanide, Zinc Chloride, 96-hr TLM Naphthenic acids, *Interactions.

Lepomis macrochirus were used in bioassays testing the toxicity of acetaldehyde, acetic acid, aceton, potassium cyanide, potassium dichromate, copper, naphthenic acids, and zinc chloride, both individually and combined. The TLM's were 53.0 ppm, 75.0, 8300, 0.18, 113, 1.25, 5.6, and 4.2 ppm, respectively. No dramatic interaction between the various components of the mixtures tested was evident. The authors stress the continued need of segregating certain waste components for intensive treatment before disposal or composting with other wastes. (Sjolseth and Katz-Washington)
W70-07549

A STUDY OF THE WATER ENVIRONMENT IN SOUTHEAST GEORGIA STRAIT IN ASSOCIATION WITH THE INTALCO ALUMINUM PLANT, II,
Washington Univ., Seattle. Coll. of Engineering.
E. B. Welch, D. W. Jamison, W. G. Williams, and R. F. Christman.
Special Report, Department of Civil Engineering, July 24, 1969. 180 p, 3 appendices, 6 refs, 13 tab, 17 fig.

Descriptors: Bioassay, *Water pollution effects, On-site investigations, Water quality, Intertidal areas, *Biological communities, *Benthic fauna, Invertebrates, On-site data collections, *Standing crop, Water analysis, Fluorides, Sockeye salmon, Bottom sediments.
Identifiers: *Aluminum plant, Georgia straits, Washington, *Community structure, Intertidal sand communities, Barnacles, Waste distribution.

The intertidal communities varied greatly but did not show a significant response to the Intalco Aluminum waste-water. The most noticeable deleterius effect upon invertebrate organisms was upon barnacles and hydroids within 20 feet of the plant diffuser. A reduction in species number was noticed in the benthic grab samples in the vicinity of the diffuser. Laboratory bioassays revealed no acute effect up to 33% waste on juvenile sockeye salmon and Dungeness crabs. Authors concluded that an effect of the Intalco waste-water on invertebrate fauna is detectable only in the immediate vicinity of the diffuser. (Sjolseth and Katz-Washington)
W70-07550

REGISTRATION AND CLEARANCE OF CHEMICALS FOR FISH CULTURE AND FISHERY MANAGEMENT,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
Elwood A. Seaman, H.W. Hays, C. R. Walker, R. A. Johnson, and J. G. Cummings.
Fish and Chemicals - A Symposium held at the 99th Annual Meeting of the American Fisheries Society, New Orleans, La., Sept 12, 1969. 73 p, 16 tab.

Descriptors: *Fish control agents, *Fish management, Public Health, Fish diseases, Fish toxins, *Piscicides, *Herbicides, 2, 4 - D, Copper sulfate, Diquat, Antimycin A, Rotenone, *Regulation, Administrative agencies, *Legal aspects.
Identifiers: *Fish culture, *Anaesthetics, Cyanide, Petroleum oil.

This symposium contains 4 papers. Three of these, by R. E. Johnson, J. G. Cummings, and H. W. Hays deal with the registration and clearance of chemicals used in fish culture and management. The fourth paper, by C. R. Walker on the problems in clearance and registration of chemicals used by fish culturists and fishery biologists, discusses the problem, gives information and current status of use and registration of chemicals. The chemicals discussed are classified into the groups: Herbicides, piscicides, disinfectants and pest control other then fish, external and internal therapeutic agents and anesthetics. (Sjolseth and Katz-Washington)
W70-07551

EFFECTS OF DECAYING BARK ON INCUBATING SALMON EGGS,
International Pacific Salmon Fisheries Commission, New Westminister (British Columbia).
J. A. Servizi, D. W. Martens, and R. W. Gordon.
Progress Report No 24, 1970. 28 p, 6 figs, 10 tab, 19 refs.

Descriptors: Bioassay, Water pollution effects, *Bark, *Sockeye salmon, *Mortality, *Sphaerotilus, Water pollution sources, Decomposing organic matter, Water quality, *Oxygen requirements, *Biochemical oxygen demand, Hydrogen sulfide, Hydrogen in concentration, *Fish eggs, Fish toxins, *Fishkill, Incubation, *Gravels.
Identifiers: *Bark pollution, *Decay processes, Incubation times.

The effect of bark contamination on salmon spawning grounds was assessed in laboratory tests on sockeye salmon (Oncorhynchus nerka) eggs and alevins. Bioassays showed that chemical toxicity of materials leached from bark of Douglas fir, Lodgepole pine, Engelmann spruce and Alpine fir was not a factor influencing survival under the conditions tested. However, abundant growths of Sphaerotilus occurred on bark during initial stages of decay, causing severe mortalities among sockeye eggs and alevins owing to suffocation. In gravel-filled incubation boxes, contamination of gravel with bark caused significant reductions in survival from egg to fry at bark concentrations of 10% by volume, but 1% bark concentrations did not influence survival. Mortalities were attributed to blockage of intragravel water flow by bark particles. Possible effects of various oxygen concentrations on size and emergency timing of fry were discussed and limiting amounts of bark recommended. (Sjolseth and Katz-Washington)
W70-07552

5D. Waste Treatment Processes

NEUTRALIZATION OF HIGH FERRIC IRON ACID MINE DRAINAGE,
Federal Water Quality Administration, Norton, W. Va. Norton Mine Drainage Field Site.
Roger C. Wilmoth, and Robert B. Scott.
Available from the Clearinghouse as PB-192 087, $3.00 in paper copy, $0.65 in microfiche. Paper presented before Third Symposium on Coal Mine Drainage Research, Mellon Institute, Pittsburgh, Penn, May 19, 1970. 28 p, 5 fig, 17 tab, 7 ref. FWQA Project 14010---5/70.

Descriptors: *Acid mine water, *Water pollution treatment, *Neutralization, Chemical reactions, Water chemistry, Iron, Limestone, Acidity, Acids, Alkalinity, Lime, Costs.
Identifiers: Soda ash, Acid mine water treatment.

The Norton Mine Drainage Field Site of the Federal Water Quality Administration has been conducting research on the feasibility of acid mine drainage treatment using lime, limestone, and soda ash neutralization. The Norton research facility is located at Norton, West Virginia, on the banks of Grassy Run--a small, heavily polluted stream of which an estimated 90% of the water flow is from abandoned mines. Tests were run on identical samples of Grassy Run water to determine the quality of the supernatant when the sample was neutralized to various pH's. Lime, limestone, and soda ash were each tested as the neutralizing agents. All 3 neutralizing agents--lime, limestone, and soda ash--can meet the pH 6.5, net alkalinity, iron below 7.0 ppm criteria with relative ease. The major differences between soda ash neutralization and lime or limestone neutralization are that soda ash produces low hardness, low calcium, high sodium, and high cost, whereas all other chemical parameters are comparable between the 3 neutralizing agents. (Knapp-USGS)
W70-07149

WASTEWATER REUSE - A SUPPLEMENTAL SUPPLY,
Los Angeles County Sanitation District, Calif.
John D. Parkhurst.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA3, Paper 7318, p 653-663, June 1970. 11 p, 1 fig, 5 tab.

Descriptors: *Water reuse, *California, Water supply, Water requirements, Water resources development.
Identifiers: *Los Angeles (Calif).

Los Angeles County obtains water from any sources. Completion of the California Water Project in 1971-72 and the second barrel of the Owens River Aqueduct in 1972 will ensure adequate supplies until about 1990. These high quality imported waters will also enhance the quality of treated wastewater for subsequent reuse. Much of this better quality water will be used directly for irrigation or percolation to the underground. Ultimately, demineralization of wastewater may be practical on a large scale, since processes now under development appear competitive with alternative sources of supply. While a significant quantity of wastewater is suitable for treatment and reuse, it should be considered in its proper role - as a supplemental supply. (Knapp-USGS)
W70-07151

COTTON BLEACHING AND DYEING WASTES - A SPECIFIC SOLUTION AND A GENERAL PRESCRIPTION,
W. B. Hart.
Industrial and Engineering Chemistry, Vol. 49, No. 3, p 81-82, 1957.

Descriptors: *Aeration, *Dialysis, Alkalinity, Color, Biochemical Oxygen Demand, Chlorine, *Waste water treatment, Textiles.
Identifiers: *Cotton bleaching wastes, *Cotton dyeing wastes, *Water Scrubber tower, *Upward flow sedimentation tank, *Kier scouring, *Soil treatment bed, *Recovery (Waste), *Biological filtration, *Mercerizing wastes, *Dyehouse wastes, Suspended matter, pH, Percolating filter, Decolorizing sodium hydroxide, Chemical Coagulation, Sodium peroxide.

The characteristics of waste waters from bleaching and dyeing of cotton that require correction are high alkalinity, suspended matter, color, and BOD. The pH value of the bleaching waste water is first reduced with flue gas, which has previously been cleaned in a water scrubber tower. The waste water is then treated in an upward-flow sedimentation tank before filtration through a two-stage percolat-

ing filter with recirculation of effluent. Waste waters from the cleaning and decoloring of foreign cotton goods by kiering with sodium peroxide are highly colored and strongly alkaline; these waste waters can be decolorized with Cl2 before mixing with other bleaching wastes. Waste waters from the kiering of cotton to remove oil and grease are strongly alkaline, contain suspended matter, are red-brown in color, and have a high BOD. One method of treatment of these waste waters involves adjustments of the pH value to 6.0-6.5 with a cheap acid, aeration, upward-flow sedimentation, and flow across a gently sloping soil treatment bed to reduce the BOD. NaOH can be recovered economically from mercerizing waste waters by dialysis; when the volume of waste is large, it should first be concentrated. Waste waters from the dyeing process may contain suspended dye matter or true color. They can be treated by chemical coagulation, upward-flow sedimentation, and biological filtration. (Robinson and Livengood-North Carolina State Univ)
W70-07237

INDUSTRIAL APPLICATIONS OF STARCHES IN THE PAPER AND TEXTILE INDUSTRY,
A. Harsveldt.
Chemistry and Industry, No. 51, p 2062-2070, 1961.

Descriptors: *Biochemical oxygen demand, Textiles, *Waste water treatment, Pulp and paper industries.
Identifiers: *Starch, *Textile mill wastes, *Starch hydroxyethyl ethers, Starch hydroxypropyl ethers, Warp sizing, Desizing.

The uses of various forms of starch in the paper and textile industries are described. The use of hydroxyethyl and hydroxypropyl ethers of starch lowers the BOD of the resulting waste waters, the reduction in BOD being greater the higher degree of substitution of the starch product. A reduction in BOD of 70% could be obtained by a degree of substitution of 0.1. (Robinson and Livengood-North Carolina State Univ)
W70-07239

EVALUATION METHOD OF COMMERCIAL ENZYMIC DESIZING AGENTS,
U. Miyaoka, and M. Masunaga.
Journal of the Society of Textile Cellulose Industries of Japan Vol. 9, p 605-608, 1953.

Descriptors: *Analytical techniques, Chemical analysis, *Solubility, Waste water treatment.
Identifiers: *Starch, *Dyehouse wastes, Desizing, Warp sizes.

The solubility of simple starch size was determined in order to estimate the transition of a sizing agent into a soluble state. This simple method was applied to compare commercial enzymic desizing agents and also to detect the residual starch on fabrics within plus or minus 5% error. (Livengood and Work-North Carolina State Univ)
W70-07245

THE BULL-RUSH EATS PHENOL,
Reinhold Kickuth.
Translated from Deutscher Forschungsdienst, Vol 14, No 14, p 1-2, 1969. Northeastern Wisconsin Regional Planning Commission, Appleton. Typescript, 3 p, 1969.

Descriptors: *Bulrush, *Phenols, *Waste water treatment, *Pilot plants, Biochemistry, Water pollution, Tertiary treatment, Water conservation, Industrial wastes, Organic compounds, Nutrients, Metabolism, Toxicity, Domestic wastes, Aromatic compounds, Potable water.
Identifiers: *Bodensee (Germany), Lake Constance, Salicylic acid.

A new process for treatment of sewage plant waste streams in which higher plants convert the dissolved and colloidal materials, is under investigation in a pilot plant at Lindau, Germany. Observations were confirmed by quantitative basic research at Gottingen University (Germany) that intensive purification of waste-loaded water takes place in the sphere of influence of certain water plants. These have the ability to take up substantial quantities of organic compounds in addition to their normal requirement of mineral nutrients and to utilize these in their metabolism. They can even absorb materials which generally have a toxic effect. It was demonstrated that the bulrush can take up phenol, salicylic acid, and other aromatic compounds and metabolize them. The route of degradation of phenol, similar to certain microorganisms, is oxidation and scission of the aromatic ring. The load factor, the seasonal dependence of the degradation output, suitable tanks, and the nature of th intermediate fraction are being investigated. The immediate goal is the inclusion of bulrushes in the design calculations of water conservation programs. (Jones-Wisconsin)
W70-07259

DISTRIBUTION OF FUNGI IN A WASTE-STABILIZATION POND SYSTEM,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
W. Bridge Cooke, and George S. Matsuura.
Ecology, Vol 50, No 4, p 689-694, 1969. 1 fig, 3 tab, 5 ref.

Descriptors: *Fungi, *Oxidation ponds, *Sewage, Yeasts, Sampling, Sewage treatment, Self purification, Decomposing organic matter, Cultures, Population.
Identifiers: Lebanon (Ohio).

Plating and enrichment culture techniques were used to determine fungus population in a small waste stabilization pond system. The entire system and an adjacent stream yielded 212 species of filamentous fungi and yeasts. A year after the establishment of the system, the number of fungal and yeast species increased 5-fold and the number of colonies 200-fold. The results of the study indicated that fungi are among saprobic organisms that play an important part in the removal of organic wastes from water stabilization ponds. (Wilde-Wisconsin)
W70-07274

TREATMENT OF MINE DRAINAGE BY INDUSTRY IN PENNSYLVANIA,
Pennsylvania Dept. of Health, Harrisburg. Div. of Mine Drainage.
Walter N. Heine, and Ernest F. Giovannitti.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA3, Paper 7362, p 743-755, June 1970. 13 p, 5 fig, 2 tab, 2 ref.

Descriptors: *Acid mine water, *Waste water treatment, *Pennsylvania, *Water pollution control, Neutralization, Aeration, Sludge disposal, Legislation.
Identifiers: Mine drainage treatment, Acid mine drainage.

Polluting mine drainage from active mines can and is presently being successfully treated by almost 200 coal companies in Pennsylvania. The increasing level of pollution from coal mining in Pennsylvania resulted in the passage of stricter laws to regulate mining. In order to comply with these laws, mining companies are being required to construct and operate mine drainage treatment plants whenever pollution exists or is anticipated from a mine. All of the treatment plants constructed to date involve various combinations of neutralization, aeration, settling, and sludge disposal. Although further development of mine drainage treatment technology will undoubtedly bring about further refinement and sophistication of treatment, the plants now operating are successfully preventing polluting discharges as defined by the State regulatory standards. (Knapp-USGS)
W70-07346

SOIL SYSTEMS FOR LIQUID WASTE TREATMENT AND DISPOSAL: ENVIRONMENTAL FACTORS,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
Warren A. Schwartz, and Thomas W. Bendixen.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 624-630, April 1970. 7 p, 8 tab, 4 ref.

Descriptors: *Soils disposal fields, *Ultimate disposal, *Soil-water-plant relationships, Soil water movement, Water levels, Waste water treatment, Groundwater movement, Soil physical properties, Soil properties.
Identifiers: Soil disposal-systems.

A number of environmental factors were investigated for their effect on the treatment potential and hydraulics of soil disposal systems. The effect of depth to groundwater was to restrict both hydraulic longevity and treatment efficiency in shallow (2 to 4 ft) systems, probably because of limited reaeration opportunity in the unsaturated zone. The adverse effects of low temperature on treatment and hydraulics can be overcome by (a) achieving biological maturity in the soil system during warmer periods, (b) using a highly adsorptive soil medium, or (c) prenitrification of the waste. Vegetation on the soil surface greatly increases hydraulic longevity and supplements treatment efficiency through plant assimilation of nitrogen and phosphate. (Knapp-USGS)
W70-07348

BUILDING FOR THE FUTURE--THE BOSTON DEEP-TUNNEL PLAN,
Camp, Dresser and McKee, Boston, Mass.
Charles A. Parthum.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 500-510, April 1970. 11 p, 3 fig, 2 tab.

Descriptors: *Storm runoff, *Water storage, *Water pollution control, *Massachusetts, Sewers, Tunnels, Sewage disposal, Cities, Costs, Cost-benefit analysis.
Identifiers: Boston (Mass).

A deep-tunnel storage plan has been proposed to prevent pollution due to discharge of wastewater overflows and mixed wastewater and stormwater from the combined sewers of Boston and adjacent municipalities. Other methods such as complete sewer separation, chlorination tanks, and holding tanks were considered, but the deep-tunnel system appeared most economical. Construction costs were estimated at $430 million and capitalized operation and maintenance at $66 million. The proposed system consists of 17.2 miles of 33-ft diam deep tunnels in a radial pattern, a pumping capacity of 2,400 cfs and a 45,000-ft ocean outfall with diffusers. The system is designed to handle runoff from the 15-yr-frequency storm of 24-hr duration within 2 days, without surcharging, and the maximum recorded storm for Boston if surcharging is permitted. (Kmapp-USGS)
W70-07364

WATER -- 1969.
For primary bibliographic entry see Field 05G.
W70-07380

FREEPORT SULPHUR COMPANY'S POLLUTION CONTROL PROGRAM (SPECIAL REFERENCE TO OFFSHORE),
Freeport Sulphur Co., Belle Chasse, La.
For primary bibliographic entry see Field 05G.
W70-07386

IN SITU TREATMENT OF RIVERS AND STREAMS,
Dow Chemical Company, Walnut Creek, Calif.
Melvin F. Katzer.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by Amer-

ican Institute of Chemical Engineers, New York, p 81-85, 1969. 5 p, 1 fig, 10 ref.

Descriptors: *Water pollution treatment, *Suspended load, *Desilting, *Turbidity, Flocculation, Sediment control, Biochemical oxygen demand, Coliforms, Solutes, Adsorption, Clays, Silts.
Identifiers: Potomac River.

Laboratory and field tests were performed to show that muddy rivers and streams can be successfully treated with synthetic flocculants to remove the suspended solids. This process can be used to protect or improve the aesthetic appearance and recreational value of a stream or a body of water into which the stream flows. (See also W70-07380) (Knapp-USGS)
W70-07388

REVERSE OSMOSIS PROCESS FOR WATER REUSE APPLICATION,
Office of Saline Water, Washington, D.C.
K. C. Channabasappa.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 140-147, 1969. 8 p, 9 fig, 10 tab, 2 ref.

Descriptors: *Water reuse, *Reverse osmosis, *Water costs, Economics, Reclaimed water, Desalination, Desalination processes, Industrial wastes, Industrial water.
Identifiers: Industrial water reuse.

Technical details of the reverse-osmosis waste water treatment process and an economic evaluation of its application to the treatment and reuse of secondary sewage effluents or industrial water wastes are presented. Under present conditions, costs range from 20 to 35 cents/1,000 gal; advances in reverse-osmosis membrane technology in the near future are expected to lower these costs further. (See W70-07380) (Knapp-USGS)
W70-07389

THE ENGINEERING EVALUATION OF REVERSE OSMOSIS AS A METHOD OF PROCESSING SPENT LIQUORS OF THE PULP AND PAPER INDUSTRY,
Sulphite Pulp Manufacturers Research League, Inc., Appleton, Wis.; and American Standard, New Brunswick, N.J.
A. C. F. Ammerlaan, and A. J. Wiley.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 148-155, 1969. 8 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Water reuse, *Reverse osmosis, *Pulp wastes, *Water costs, Reclaimed water, Economics, Sulfite liquors, Byproducts, Water pollution control, Membrane processes.
Identifiers: Pulp waste processing.

Evaluation of data from the first of six, 3-mo. trials of a large (50 to 100,000 gal/day) pilot scale reverse osmosis processing unit operating at various pulp mills and on different types of spent liquors, confirms 90% or better recovery of high quality water and rejections of dissolved organics and inorganics at the 90 to 99% level in the concentrate. The unit operated 46% of available time to process 1,260,000 gal. of calcium base sulfite wash water containing 1% solids and concentrated to the 7 to 16% range. Problems encountered included reliability of mechanical equipment, pumps, pH control, membrane module failures and processing problems for control of gypsum scale, and membrane fouling with silicate-pitch complexes. All problems except life of membrane modules were found capable of being handled satisfactorily. Membrane equipment life requires further development by suppliers. Costs were found to be well below other methods of concentration such as by evaporation. (See also W70-07380) (Knapp-USGS)
W70-07390

INSTALLATION AND OPERATION OF UPWARD-FLOW CLARIFIERS AT WORKS OF THE LICHFIELD RDC,
K. G. Pullen.
Water Pollution Control, Vol 68, No 6, p 635-638, Nov-Dec 1969. 3 fig.

Descriptors: *Sewage treatment, *Design, Installation, Cost, Waste water treatment.
Identifiers: *Upflow clarifiers, Surface loading, Backwashing, Clarifiers.

During a two and one-half year period clarifiers were installed at three small sewage treatment plants (7000-24,500 Imperial gallons/day). In two cases the clarifiers were installed in the humus tanks while in the other case a separate unit was constructed. Information concerning the design, installation and performance of the clarifiers is given. Satisfactory effluents were produced at surface loadings of less than 20 Imp gallons/hour. The use of small stone or pea gravel in the bottom of the clarifier resulted in the need to backwash daily; while if larger medium, 3/4 to 1 inch were used backwashing was necessary at two-week or longer intervals. Construction and installation cost data are given. (DiFilippo-Texas)
W70-07445

DISPOSAL OF TITANIUM PROCESS WASTES,
National Lead Co., Sayreville, N.J.
Lincoln Peschiera, and Frank H. Freiherr.
Journal Water Pollution Control Federation, Vol 40, No 1, p 127-131, Jan 1968.

Descriptors: *Industrial waste, *Disposal, *Acid, Waste water treatment, Concentration (Composition), Neutralization, Slaking.
Identifiers: *Titanium dioxide pigment, Barging, Sea disposal, Sulfuric acid, Ferrous sulfate.

Titanium dioxide in an inert, non-toxic white pigment produced in various areas for use in the paint, paper, plastic, drug, and ceramic industries. Wastes generated in the process consist of dilute sulphuric acid, soluble salts (primarily ferrous sulfate), and insoluble materials (particularly silica) and unrecovered titanium dioxide. The described plant has three disposal methods: (1) disposal at sea, consisting of a rubber lined shore storage facility for collecting, and barges for disposal of acidic wastes and slurries at sea, (2) waste treatment facilities consisting of a neutralization facility which titrates to a pH of 4.0 and subsequently discharges to the Middlesex County Sewage Authority collection system, (3) a lagoon system providing clarification and cooling of coolants and wash water with pH adjustment if required followed by discharge to Raritan river estuary. Better than 99.5% of the waste generated is recovered in the disposal system. The entire operation requires 6 mgd of fresh water from deep-wells and 44 mgd of brackish water from the Raritan River estuary. (Hancuff-Texas)
W70-07446

DYNAMIC MODEL OF THE ANAEROBIC PROCESS,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
John F. Andrews.
Journal of Sanitary Engineering Division, American Society of Civil Engineers, Vol 95, No SA1, p 95-116, February 1969. 18 fig, 31 ref. FWA WP-00622.

Descriptors: *Anaerobic digestion, *Simulation analysis, *Inhibition, *Hydrogen ion concentration (pH), Anaerobic bacteria, Laboratory tests, Waste water treatment.
Identifiers: *Dynamic model, *Volatile acid concentration, *Process stability, Pactorus.

Process stability has been the major problem associated with the anaerobic digestion process. A dynamic model which utilizes an inhibition function to predict the failure of an anaerobic digester was presented. The key features of the model were: (1) The use of an inhibition function to relate volatile acid concentration and specific growth rate for the methane bacteria; and (2) consideration of the un-ionized acid as the growth-limiting substrate and inhibiting agent. The consideration of the un-ionized acid as the inhibiting agent resolves the conflict between volatile acid inhibition and pH inhibition because the concentration of un-ionized acid is a function of both total volatile acid concentration and pH. The model was kept as simple as possible by assuming that there was no lag phase, organism death, endogenous respiration, substrate utilization for maintenance energy, or inhibition by products. Experimental evidence from laboratory studies and evidence from the bacteriological literature were presented in support of the model. Simulation studies, utilizing a digital-analog simulation program (PACTORUS), of both batch and continuous flow systems provided additional evidence by predicting results commonly observed in the field during the start-up, or failure, or recovery of anaerobic digesters. The simulation studies should be considered as only semiquantitative as reliable values of the growth parameters were not available. (Calwardi-Texas)
W70-07448

ATTACHED GROWTH OF SPHAEROTILUS AND MIXED POPULATIONS IN A CONTINUOUS-FLOW APPARATUS,
Rutgers - The State Univ., New Brunswick, N.J.
F. F. Dias, Norman C. Dondero, and M. S. Finstein.
Applied Microbiology, Vol 16, No 8, p 1191-1199, Aug 1968. 5 fig, 7 tab, 17 ref.

Descriptors: *Sphaerotilus, *Slime, Nitrogen, Dissolved oxygen, Carbohydrates, Flow rates, Sewage bacteria.
Identifiers: *Sewage fungus, Continuous-flow apparatus, Mixed cultures, Pure cultures, Sludge bulking.

The term 'sewage fungus', also called slime infestation, describes a group of organisms comprised of bacteria and protozoa, as well as true fungi, that grow attached to surfaces in polluted water courses. Probably the most important form of slime infestation is caused by Sphaerotilus. Sphaerotilus has also been implicated in sludge bulking in the activated sludge process. The environmental factors which allow Sphaerotilus to grow in successful competition with other members of the biota was investigated by the use of continuous-flow vessels. Twelve vessels were innoculated with S. matans, sewage, or both and the effects of NH4Cl, organic nitrogen, dissolved oxygen, and gluose concentrations as well as flow rate are described. Increased levels of gluose did not result in the selection of Sphaerotilus over other organisms indicating that sludge bulking due to Sphaerotilus is due to nitrogen deficiency rather than increased carbohydrates. Initial low dissolved oxygen, 1 mg/l, favored the growth of Sphaerotilus in mixed populations but not in pure cultures. At low NH4Cl concentrations 0.2-1 mg/l, Sphaerotilus were dominant in slimes; but when the concentration was increased to 5 mg/l this dominance was no longer evident. Increases in organic nitrogen concentrations gave increased slime growth but led to no dominance. (DiFilippo-Texas)
W70-07449

CONTINUOUS OXIDATIVE ASSIMILATION OF ACETIC ACID AND ENDOGENOUS PROTEIN SYNTHESIS APPLICABLE TO TREATMENT OF NITROGEN-DEFICIENT WASTE WATERS,
Oklahoma State Univ., Stillwater.
A. F. Gaudy, Jr., K. C. Goel, and Elizabeth T. Gaudy.
Applied Microbiology, Vol 16, No 9, p 1358-1363, Sept 1968. 4 fig, 1 tab, 12 ref. FWQA Grant WP 00325.

Descriptors: *Nitrogen, *Activated sludge, Deficient elements, Chemical oxygen demand, Ammonium compounds, Waste water treatment, Industrial wastes.

A modification of the activated sludge process for the treatment of nitrogen deficient wastes involves the nitrogen supplement not being added to the waste water. Instead the waste is contacted with an acclimated biomass and the carbon source is removed by oxidative assimilation. The biological solids are settled and a portion subjected to endogenous respiration in the presence of extra-cellular nitorgen. A laboratory scale unit operating on this principle was fed 1000 mg/l of acetic acid. Aeration time of waste water was twelve hours. A portion of the sludge was aerated in the presence of ammonium sulfate for twelve hours. Ratios of influent chemical oxygen demand (COD) to nitrogen studied were: 30:1, 50:1, and 70:1. COD removal efficiencies of 87 to 91 per cent were observed. Ammonia nitrogen in the effluent ranged from 0 to 4 mg/l. The study represents the most critical test to which the process has been subjected and suggests that the process may provide cost savings and curtailment of nitrogen leakage in effluents. (DiFilippo-Texas)
W70-07451

GREASE REMOVAL AT A MUNICIPAL TREATMENT FACILITY,
Cornell Univ., Ithaca, N.Y.
Raymond C. Loehr, and Carlos T. de Navarra, Jr.
Journal of the Water Pollution Control Fed., Vol 41, No 5, Part 2, p R142-R154, May 1969. 6 fig, 7 tab, 17 ref.

Descriptors: *Waste water treatment, *Biochemical oxygen demand, *Lipids, *Suspended solids, Chemical oxygen demand, Municipal waste, Activated sludge.
Identifiers: *Grease, Primary treatment, Secondary treatment, Thin layer chromatographs.

An activated sludge municipal waste treatment facility was studied to determine the concentration and types of grease in treated and untreated waste waters, to determine typical grease removal efficiencies, and to compare grease removal with other performance parameters. Laboratory samples were analyzed for biochemical oxygen demand, suspended solids, and volatile suspended solids. The wet extraction technique determined the grease concentration and thin layer chromatography determined the lipid classes present in the total grease (lipid) extract. The data showed that: (a) the average influent grease concentration varied with biochemical oxygen demand and chemical oxygen demand, but not suspended solids, and was an average of 147 mg/l (0.11 lb/day/cap); (b) only biological treatment altered the relative proportion of the lipid classes; (c) primary clarifiers removed approximately 45% of both grease and suspended solids; (d) the secondary system removed 78% biochemical oxygen demand, 74% grease and 69% suspended solids; and (e) overall plant removal efficiencies were 84% grease, 82% suspended solids, and 85% biochemical oxygen demand. (Waid-Texas)
W70-07452

EVALUATION OF THE LOADING PARAMETERS FOR ANAEROBIC DIGESTION OF CANE MOLASSES DISTILLERY WASTES,
All-India Inst. of Hygiene and Public Health, Calcutta.
I. Radhakrishnan, S. B. De, and B. Nath.
Journal of the Water Pollution Control Federation, Vol 41, No II, R 431-440, Nov. 1969. 1 fig, 3 tab, 11 ref.

Descriptors: *Anaerobic digestion, *Industrial wastes, *Performance, Biochemical oxygen demand, pH, Efficiencies, Pilot plants, Waste treatment.
Identifiers: *Volatile acids, *Loading rates, *Detention time, *Distillery wastes, Molasses waste.

The effect of loading rate variations on the anaerobic treatment of a molasses distillery waste was investigated. Four 10 liter laboratory digesters were loaded at 0.094 lb BOD/day/cu ft while detention times varied from 4 to 20 days. Results showed that better digestion was accomplished with diluted feed as compared with concentrated raw waste feed as high volatile acids concentrations and low pH values developed with the raw feed. An upper limit of 241 mg/l of sulfides was reported as compared to an inhibitory upper limit of 100 mg/l previously reported. Results from increased loading rate studies indicated that a loading rate of 0.188 lb BOD/day/cu ft could be maintained using a raw waste feed while a loading rate of 0.226 lb BOD/day/cu ft could be maintained using a diluted waste feed. BOD removal efficiency ranged from 80 to 87 percent. Results also indicated that two-stage digestion utilizing shorter detention times would be better for treating high organic wastes than single-stage digestion with a longer detention time. (Galwardi-Texas)
W70-07453

GRAVITY THICKENING TECHNIQUES AT A WATER RECLAMATION PLANT,
Amarillo, Tex.
V. J. Jordon, Jr., and C. H. Scherer.
Journal of the Water Pollution Control Federation, Vol 42, No 2, p 180-189, Feb. 1970. 6 tab, 2 ref.

Descriptors: *Activated sludge, *Sludge treatment, Lagoons, Flocculation, Waste water treatment, Sewage treatment.
Identifiers: *Clarifers, *Thickening, *Blow down, *Bulking, Cationic, Anionic, Polymers.

Various modifications were attempted to control bulking of clarifers in a system handling maximum loads approximately twice the design standards. Blowdown of the final clarifer to an oxidation pond was only a temporary solution as the oxidation pond rapidly began to fill with activated sludge. The use of an empty aerator as a primary effluent holding tank proved to be unsuccessful. The results of the use of an anionic polymer for raw waste water flocculation did not warrant the $5.00/million gal. cost. Flocculation with a cationic polymer of the mixed liquor entering the final clarifers was found to be too expensive at a cost of $8.90/hr of bulking. A 2 million gallon holding tank was constructed as a temporary assistance. Five cationic polymers were used on a plant scale forloadings ranging from 4.5 to 6.97 lb/day/sq. ft. Costs ranged from $1.10 to $3.64/ton of influent suspended solids. A problem of phosphate scale developed in the digester supernatant line system and was alleviated with a hexametaphosphate-lignin compound. (Galwardi-Texas)
W70-07454

THEORY OF SAND FILTRATION,
Bengal Engineering Coll., Howrah (India).
Arun K. Deb.
Journal of the Sanitary Engineering Division Proceedings of American Society of Civil Engineers, Vol 95, No SA3, p 399-422, June 1969. 11 fig, 2 tab, 22 ref.

Descriptors: *Filtration, *Mathematical model, Dimensional analysis, Head loss, Hydraulic gradient.
Identifiers: *Sand filtration, Pore geometry, Filter coefficient, Specific deposit, Filtration time.

The study is an attempt to present a comprehensive filtration theory. A modified mathematical model of filtration of a dilute unisized suspension in water through a homogenous sand filter bed under constant rates of vertically downward flow is presented. The model includes all physical variables involved in filtration to describe the space-time variation of concentration of suspension, specific deposit and hydraulic gradient in the filter medium during a filter run. An expression for dimensionless filter coefficient relating all physical variables of filtration is obtained by dimensional analysis. Solution of the filtration equation is obtained by finite difference method. Computed suspension concentrations at different time intervals and depths of bed agree will with the experimental results. An equation relating head loss per unit depth and specific deposit within the filter bed is derived and the validity of the proposed equation is verified with experimental head loss data. (Shankar-Texas)
W70-07455

ACTIVATED-SLUDGE NITRIFICATION IN THE PRESENCE OF LINEAR AND BRANCHED-CHAIN ALKYL BENZENE SULFONATES,
Wisconsin Univ., Madison.
Charles R. Baillod, and W. C. Boyle.
Applied Microbiology, Vol 16, No 1, p 62-68, Jan. 1968. 6 fig, 2 tab, 18 ref.

Descriptors: *Alkylbenzene sulfonates, *Activated sludge, *Nitrification, Nitrite, Nitrate, Surfactants, Linear alkylate sulfonates, Dissolved oxygen, Detergents.
Identifiers: Branched chain alkyl sulfonates.

Eight batch type, laboratory scale activated sludge units were fed a synthetic substrate of milk solids, nutrients and buffer at intervals of 24 hours. Three units were fed linear alkyl benzene sulfonates (LAS) at concentrations of 6.6, 13.8, and 23.0 mg/l; three units were fed branched-chain alkyl (ABS) benzene sulfonates at concentrations of 6.6, 13.0 mg/l; and two units were used as controls. The units were run with no sludge wasted and dissolved oxygen concentrations between 8 and 9 mg/l. After twenty-nine days of operation almost all of the oxidized nitrogen in the effluent of units fed sulfonates was in the form of nitrate while in the control units only about half of the oxidized nitrogen was in the form of nitrates. Oxidized nitrogen concentrations increased with increasing sulfonate concentrations up to a point and then decreased. In the inhibition range, ABS exhibited proportionately greater effects on the oxidized nitrogen levels than did similar concentrations of LAS. Several hypothesis are suggested to explain the results observed. (DiFilippo-Texas)
W70-07456

AN INVESTIGATION OF SLUDGE DEWATERING RATES,
Massachusetts Univ., Amherst.
John H. Nebiker, Thomas G. Sanders, and Donald Dean Adrain.
Journal of the Water Pollution Control Federation, Vol 41, No 8, Aug. 1969, p R255-R266. 11 fig, 2 tab, 13 ref.

Descriptors: *Design, *Dewatering, *Sludge disposal, Waste water treatment, Digestion, Filtration, Theoretical analysis, Activited sludge, Sludge treatment.
Identifiers: *Dewatering rate, *Drying beds, Pilot-study, Specific resistance, Media factor.

Waste water sludge disposal is one of the most vexing problems of water pollution control. Nearly 25 to 65 percent of total capital and operating costs of primary and secondary treatment plants are expended in handling sludge. It therefore becomes necessary to place more emphasis on volume reductions of the sludge prior to its ultimate disposal. Nearly 72% of treatment plants in the united States utilize sludge drying beds. Past research and gravity dewatering shows very few formulations equating dewatering rates to inherent sludge characteristics. The paper presents theoretical analysis relating depth of sludge and time with the solids-content, specific resistance and coefficient of compressibility. The developed formula is verified experimentally. Further, all parameters are readily determinable by simple laboratory tests, thus presenting an accurate analytical method to predict gravity dewatering and provide a rational basis for selection and optimization of a sludge dewatering system. (Shankar-Texas)
W70-07457

STATE PROGRAMS FOR EXAMINING AND CERTIFYING WASTE WATER TREATMENT PLANT OPERATORS.
Public Administration Service, Chicago, Ill.

Journal of the water Pollution Control Federation, Vol 40, No 1, p 57-75, Jan. 1968. 1 fig, 3 ref.

Descriptors: *Management, *Waste water treatment, Treatment facilities, Education, Legislation, Sewage treatment, Regulation, Permits.
Identifiers: *Operators, *Certification, License.

A study of both mandatory and voluntary certification programs is made. Letters of inquiry were sent to the entire 50 states and replies were received from over 60% of those contacted. The study reveals that the principle stumbling blocks to successful installation of mandatory certification programs are the municipal governments and other employers of waste water treatment operators. They see mandatory certification as a threat to their freedom to employ whom they see fit, and as a method for operators to increase their status and salaries possibly without merit. With some justification, employers do not feel that mandatory certification itself will raise the performance level of the operators. The key is education. Only education can raise the performance level of the operators. Certification can then become a method for assuring that a certain minimum level of education has taken place. Mandatory certification can lead to reduced pollution, protection of capital investments for employers, increased pride, status, and salary of operators, and an overall better living condition for the public. Voluntary programs are a good and perhaps necessary first step. Program problems, benefits, position of interest groups and operator training are discussed. (Hancuff-Texas)
W70-07458

CATION-DEPENDENT FLOCCULATION IN A FLAVOBACTERIUM SPECIES PREDOMINANT IN ACTIVATED SLUDGE,
Tokyo Metropolitan Univ. (Japan).
Yasuhiko Tezuka.
Applied Microbiology, Vol 17, No. 2, p 222-226, February, 1969. 1 fig, 2 tab, 14 ref.

Descriptors: *Flocculation, *Activated sludge, Calcium, Magnesium, Ions, Metabolism, *Activated sludge.
Identifiers: *Flavobacterium, Cations, Taxonomical.

Of the isolates botained from plating of activated sludge, 60% appeared to belong to the genus Flavobacterium. The taxomomical properties, flocculation process, and metabolic activity of these isolates were studied. The isolates were all small rods without flagella. All the isolates required amino acids and vitamins as nutrients. To determine what kind of mineral components affect flocculation, the bacterium was grown in media containing either CaCl2, MgCl2, or both CaCl2 and MgCl2. Results showed that both calcium and magnesium ions were indispensable to floc formation, although the role of the calcium is more important than that of the magnesium ion. No other mineral salts could produce flocculation. Suspending flocs indeionized water and shaking caused disintegration of flocs. Addition of mineral salts resulted in the cells flocculating again. This reflocculation was observed with both live and dead cells suggesting that flocculation is physiochemical rather than physiological process. Since the electric charge of the cells surface was negative a possible mechanism for floc formation is that negative cell surfaces are bridged by ionic bonds intermediated by cations. (DiFilippo-Texas)
W70-07459

VALUE OF INSTRUMENTATION IN WASTE WATER TREATMENT,
Albright and Friel, Inc., Philadelphia, Pa.
Joseph J. Salvatorelli.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 101-111, Jan. 1968. 11 fig, 1 tab.

Descriptors: *Instrumentation, *Control system, *Waste water treatment, Flow, Industrial wastes, Sewage treatment, Monitoring, Operation and maintenance, Sewers.
Identifiers: *Centralized control, Meters.

Instrumentation is described as a valuable tool which if used properly by the operator will free him to perform duties which require human attention. Mechanical, physical, and chemical methods may be used to control various processes within a system. Instrumentation for specific values are described, e.g. flow measurements, liquid levels, in wet wells, operating pressure records, continuous recording, pH, temperature, and density analyzers. Specific applications are given for industrial waste treatment as well as domestic waste water. The example for the industrial waste treatment is that of a metal waste which contains heavy concentrations of cyanide, chromium and other heavy metals. Each treatment phase depends on maintaining optimum pH to assure use of the minimum amount of chemicals needed to carry out the reaction. The burdensome job of maintaining optimum pH at the beginning of each of the treatment cycles was accomplished entirely by pH instrumentation and direct control of chemical application. The second illustration of a system is designed primarily for monitoring an entire waste water disposal system including pumping stations, overflow diversion chambers, and the treatment plant. Because of the magnitude of the system, instrumentation and control at the waste water treatment plant has been limited to only those functions which were necessary for proper plant operation. Costs are usually less than 5% of the total project costs. (Hancuff-Texas)
W70-07460

ANALYSIS OF MUNICIPAL AND CHEMICAL WASTE WATERS BY AN INSTRUMENTAL METHOD,
Dow Chemical Co., Midland, Mich. Analytical Science Lab.
For primary bibliographic entry see Field 05A.
W70-07461

METABOLISM OF SOME ANIONIC TALLOW-BASED DETERGENTS BY SEWAGE MICROORGANISMS,
Eastern Regional Research Laboratory, Wyndmoor, Pa.
Theone C. Cordon, Elmer W. Maurer, M. V. Nunez-Ponzoa, and A. J. Stirton.
Applied Microbiology, Vol 16, No 1, p 48-52, January 1968. 4 fig, 1 tab, 5 ref.

Descriptors: *Detergents, *Metabolism, Chemical oxygen demand, Linear alkylate sulfonates, Activated sludge, Sewage treatment.
Identifiers: Methylene blue activity, Anionic.

Detergents in the amount of 40 mg/l were added to water containing nutrients and 10 mg/l of activated sludge. The contents were continuously stirred. Eleven types of detergents were used, including: tallow alchol sulfates, long-chain ether alcohol sulfates and x-sulfo fatty acids. Linear alkyl sulfonate (LAS) was used as a reference material. Samples were withdrawn daily. Chemical oxygen demand (COD) was measured on centrifuged samples. A methylene blue activity procedure (MBAS) was used to determine the detergent concentration of settled samples. Detergent is no longer registered in the MBAS test when the carbon chains are shortened to about six to eight carbon atoms. With reference to COD, alcohol sulfates were the most rapidly and completely metabolized (96 to 99 percent) and one ether alcohol sulfate was 94% degraded. LAS was 80% degraded and all other detergents fell in the range of 61 to 87% degraded. Except for alcohol sulfates, loss of methylene blue activity occurred long before COD values reached a minimum. With the alcohol sulfates, COD and MBAS decreased simultaneously. (DiFilippo-Texas)
W70-07463

PERSONNEL TRAINING UTILIZATION AND POLICY,
Philadelphia Water Dept., Pa.; West Virginia State Dept. of Health; Metropolitan Sanitary District of Greater Chicago, Ill.; Federal Water Pollution Control Administration, Washington, D.C.; and Water Pollution Control Ames, Iowa.
Samuel S. Baxter, Glen O. Fortney, Donald R. Morrison, Vinton W. Bacon, and John M. Rademacher.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 1-15, Jan. 1968. 2 ref.

Descriptors: *Management, *Training, Personnel, Education, Performance, Sewage treatment, Permits.
Identifiers: *Operators, *Certification, Policy, Unions.

Utilization of personnel in municipal waste water treatment and collection systems is effected by the lack of a profit motive. Management is charged however, with proper personnel training and utilization. Mandatory certification programs have succeeded in bringing about improved training and consequently, have had a net effect of improved operation, better salaries, better working conditions, and better employer-employee relationships. Efforts to organize public employees are increasing and public officials must prepare for it and face the question of defining management, negotiation, recognition, agreements, strikes, and union shops. Personnel in the field can expect greater and closer attention to the performance of their plants by state and federal authorities. Federal programs are being arranged to furnish training, and technical advisory assistance to treatment personnel. The federation, through its operator training courses and its promotion of certification is attempting to assist in improving the capability and the status of the waste water treatment plant operators. (Hancuff-Texas)
W70-07464

CITRIC ACID FROM CITRUS PROCESSING WASTES,
Florida Univ., Lake Alfred.
Sterling K. Long.
Proceedings of the Industrial Waste Conference, 23rd, p 18-25, 1968. 4 tab, 6 ref.

Descriptors: *Industrial wastes, *Fermentation, Citrus fruits, Feeds, Cation adsorption, Waste water treatment.
Identifiers: *Citric acid, *Citrus wastes, Press liquors, Molasses.

Wastes generated in the citrus industry include press liquors and plant waste water. Present practice involves evaporation of press liquor to citrus molasses which is used as a feed. Plant waste water is disposed in a variety of ways. Fermenting the carbohydrates in the waste to produce citric acid is a new approach to disposal. A mixture of 600-700 gallons of waste water and 175 gallons of molasses results in a solution of optimal total sugar content for fermentation (15-17 percent). With citric acid yields of 50-70 percent of theoretical, the gross value of acid produced is $135 - $189 per ton of molasses processed as compared to a sale value for molasses of $14-$16 per ton. Investigation showed a mixture of molasses and tap water to be suitable substrate for fermentation by A. niger. Required or desired treatment included: adsorption with cationic resins and addition of 0.3 percent ferrocyanide to remove iron. Optimum conditions included a temperature of 28-30 deg C and vigorous shaking during the first 24 hours followed by oxygen sparging during the next 24-48 hours. Yields of 25 percent of theoretical have been observed. (DiFilippo-Texas)
W70-07467

REMOVAL OF NITROGEN AND PHOSPHORUS,
Stanford Univ., Calif. Dept. of Civil Engineering.
Rolf Eliassen, and George Tchobanoglous.
Proceedings of the Industrial Waste Conference, 23rd, p 35-48, 1968. 5 tab, 16 ref.

Descriptors: *Cost comparisons, *Efficiencies, *Nitrogen, *Phosphorus, Algae, Biological treatment, Waste water treatment.
Identifiers: *Removal processes, Chemical treatment, Overfertilization, Physical treatment, Unit operations, Unit processes.

The need to remove nitrogen and phosphorus from waste waters stems from the fact that they are capable of stimulating and promoting the undesirable growth of algae and aquatic plants. The important forms of nitrogen are ammonia, nitrite and nitrate, while phosphorus may occur as soluble inorganic phosphates. Nitrogen and phosphorus removal methods may be classified as biological, chemical and physical. Biological methods include activated sludge, trickling filters and anaerobic treatment. Chemical and physical processes include ion exchange, electrodialysis, reverse osmosis and distillation. Typical removal efficiencies range between 40 to 98 percent and 30 to 98 percent for nitrogen and phosphorus compounds, respectively. In planning and designing facilities to be used for the removal of nitrogen and phosphorus, key factors which must be considered are: (1) whether compounds of one or both are to be removed, (2) the use to be made of the treated waste water, (3) the available means for disposing of the ultimate contaminants, and (4) the economic feasibility of the selected process or processes. The estimated removal costs per million gallons range from $4 to $1000 for both nitrogen and phosphorus depending on the process used and degree of treatment required. (Aguirre-Texas)
W70-07469

A SURVEY OF INDUSTRIAL WASTE TREATMENT COSTS AND CHARGES,
Stone (Ralph) and Co., Inc., Los Angeles, Calif.
Ralph Stone, and Curtis Schmidt.
Proceedings of the Industrial Waste Conference, 23rd, p 49-62, 1968. 2 fig, 6 tab, 2 ref.

Descriptors: *Costs, *Industrial wastes, *Surveys, *Treatment, *Cost allocation, Volume, Biochemical oxygen demand.
Identifiers: *Sewers, *Charges, Suspended solids.

A preliminary analysis was presented of the extent to which the cities of America have met the challenge of providing industrial waste disposal on an equitable cost basis. Estimates were projected for waste quantities generated, sewer use, and capital outlays associated with industrial waste. Approximately one-third of the cities provided for separate industrial waste charges with the majority of these using volume as the only criterion. It was reported that the average annual cost of sewage services to a citizen living in a community of under 100,000 population was approximately $20 and the average annual per capita cost in large communities was $14. The results of the questionnaire were analyzed to determine the effect of four typical sewer charge methods on the allocation of costs to industrial firms generating varying volumes of waste water and BOD. It was suggested that probably the most equitable arrangement was that in which a part of the revenues were obtained by charges based on BOD, suspended solids, and volume of wastes discharge to the sewer and another portion by property taxes on all properties. The cooperation of local industry and civic promotional groups should be solicited in drawing up an industrial sewer service charge program. (Galwardi-Texas)
W70-07470

RECOVERY OF ZINC FROM VISCOSE RAYON EFFLUENT,
Courtalds (Canada) Ltd., Cornwall (Ontario).
R. S. Aston.
Proceedings of the Industrial Waste Conference, 23rd, p 63-74, 1968. 8 fig, 3 tab, 4 ref.

Descriptors: *Ion exchange, Pilot plant, Corrosion, Economics, Waste water treatment, Industrial wastes, Textiles.
Identifiers: *Zinc, *Viscose rayon effluent, *Poisoning, Life, Regeneration-cycle, Temperature effects, Interfering ions.

Experimental methods have been adopted to remove zinc from acidic waste produced from a viscose rayon plant. The technical and economic feasibility of ion exchange for zinc recovery was explored, by a bench scale pilot plant. The main purpose was to examine the life of the resin and determine the poisoning which could be expected from low concentration organic surfactants present in the effluent stream. A 20-inch resin column of 3/4 inch diameter was used preceeded by two quartz filters to remove suspended matter. The ion exchange process is described. It is estimated that this method ensures the recovery of zinc to about 92 percent. Some organic matters and amines were found to affect the efficiency of resin to some extent. Washing the resin bed with 4 percent caustic soda solution would reduce the poisoning due to mineral oil. The resin life id dependent upon the number of cycles it is operated per day. Experimental data indicate that the life of the resin is approximately four years. This process is more effective than the evaporation method. (Shankar-Texas)
W70-07471

ANAEROBIC-AEROBIC TREATMENT OF SPENT VEGETABLE TAN LIQUORS FROM A SOLE LEATHER TANNERY,
Cincinnati Univ., Ohio.
J. David Eye, and John G. Aldous.
Proceedings of the Industrial Waste Conference, 23rd, p 126-139, 1968. 11 fig, 3 tab, 8 ref.

Descriptors: *Pilot plants, Aerobic treatment, Biological treatment, Waste water treatment, Industrial wastes.
Identifiers: *Anaerobic-aerobic lagoon, *Spent tan liquors, *Tannery wastes, Anaerobic treatment, Tannin industry.

Because of the relatively unfavorable economic position of the sole leather industry the basic criteria for a satisfactory waste treatment system include: a low capital investment; low operating costs; simplified operating procedures; flexibility in operation; small land usage; and performance capability commensurate with effluent requirements. Studies on the volumes and characteristics of the wastes from tanneries show that about 75 to 85 percent of the major pollutants are contained in only 20 to 30 percent of the total waste volume. The volume of waste water discharged from the tannery under study varied from 450 to 590 gal/hide. The two waste streams of greatest concern are the lime-sulfide liquors and the spent tan solutions, both derived from batch type processes. A detailed study of the anaerobic-aerobic procedure for treating spent vegetable tan liquors was performed in a pilot scale stratified lagoon. The anaerobic unit was loaded at approximately 960 lbs COD/1000 cu. ft./day. The overall removal efficiency of the pilot unit in treating spent tan liquors averaged about 85 percent for all parameters measured. For a total flow of 0.5 MGD and a detention period of nine days it was estimated that the capital costs and operating costs would be $50,000 and $12,000, respectively. (Aguirre-Texas)
W70-07472

A REVIEW OF CITRUS WASTES AND THEIR PROBLEMS,
Orange County Water Conservation Dept., Orlando, Fla.
C. W. Sheffield, R. R. McNary, and L. D. Killingsworth.
Proceedings of the Industrial Waste Conference, 23rd, p 140-153, 1968. 7 fig, 6 tab, 16 ref.

Descriptors: *Citrus fruits, *Waste treatment, Industrial wastes, Biochemical oxygen demand, Color, Activated sludge, Trickling filter, Lagoons.
Identifiers: Solids, Unit processes, Spray, Irrigation.

Citrus wastes from various processes are characterized and treatment for each waste discussed. Fresh fruit packaging wastes come from three sources: washing, preserving and coloring. Washing operations waste contains solids and detergents and is fine-screened. Coloring operation wastes are high in BOD and color and may be hauled to a disposal plant. Preserving operation wastes are diluted, settled and released to a drainfield. Single strength juice processing produces waste from juicing operations and clean-up waters. Juicing operation wastes, which are high in solids, are usually dried and the residue processed into cattle feed. Clean-up waters should be fine-screened and treated biologically. Sectionizing wastes are similar to those described in juicing operations. Juice concentrating wastes consist of spillage and barometric condenser water. Spillage is often processed into feed. Barometric condenser water is high in volume but low in BOD. The various unit processes applicable to citrus wastes are discussed. These processes include: lagooning, hauling, dilution, trickling filter, activated sludge, and spray irrigation. (DiFilippo-Texas)
W70-07473

THE OCCURRENCE OF FUNGI IN ACTIVATED SLUDGE,
Federal Water Pollution Control Administration, Washington, D.C.
William Bridge Cooke, and Wesley O. Pipes.
Proceedings of the Industrial Wastes Conference, 23rd, p 170-182, 1968. 5 tab, 23 ref.

Descriptors: *Activated sludge, *Fungi, Yeasts, Microbiology, Waste water treatment, Sewage treatment.
Identifiers: Colony isolation, Pour plating, Streaking, Geotrichum candidum, Trichosporon, Penicillum.

Samples of the waste, sludge and the effluent were obtained from eighteen activated sludge sewage treatment plants. Three successive tenfold dilutions were made and both streaked and pour plated on GPY agar and ND agar which are recommended for fungi. The first 35 sets of samples contained 20 fungi species or species groups. Of these, three were widely distributed: Geotrichum candidum, Trichosporon spp, and Penicillum spp. Four occured in only one set of samples each, while the other 13 species were found in two to 21 sets of samples. Only 1.18 per cent of the colonies represented yeast species. While G. candidum and Trichosporon spp were present in relatively large numbers throughout the year, other generic groups tend to be less abundant, or even absent, during the winter. Data indicate that fungi are among the active organisms in biological treatment of sewage and the population of fungi observed include species which are able to use a wide variety of substrates. (DiFilippo-Texas)
W70-07474

FIELD EVALUATION OF AERATORS IN ACTIVATED SLUDGE SYSTEMS,
Illinois Univ., Urbana.
John T. Pfeffer, Fred C. Hart, and Lawrence A. Schmid.
Proceedings of the Industrial Wastes Conference, 23rd, p 183-194, 1968. 2 fig, 8 tab, 8 ref.

Descriptors: *Aeration, *Activated sludge, Oxygen requirements, Temperature, Dissolved oxygen, Waste water treatment, Sewage treatment.
Identifiers: Contact stabilization, Alpha coefficient, Oxygen transfer rate.

Fundamental theory of oxygen transfer are developed mathematically. The oxygen transfer rate (mg/l/hr) is a function of : KLa, oxygen transfer coefficient; alpha-g, the ratio of KLa of mixed liquor to KLa at standard conditions; Cs, oxygen saturation concentration; B, ratio of Cs in mixed liquor to Cs at standard conditions; Co, oxygen concentration present; temperature; and oxygen demand rate. Equations are given to express the oxygen transfer rate as well as KLa for diffused air aeration and turbine aeration. Values of alpha, B and Oxygen demand were determined at the Topeka, Kansas contact stabilization activated sludge plant. February alpha values ranged from

0.404 to 0.576 and 0.540 to 0.720 while August values ranged from 0.335 to 0.440 and 0.540 to 0.605 for the contact tank and reaeration tank respectively. All values of B ranged from 0.97 to 1.00. Oxygen uptake rates are given for both 15 and 10 horsepower aerators in the contact tank and reaeration tanks in February and August. The ranges determined include: 48.0 to 69.3 mg/l/hr (contact tank, 15 hp, August) and 103.7 to 149.0 (Reaeration tank, 15 hp, August). (DiFilippo-Texas)
W70-07475

SHORT TERM BOD USING THE AUTOMATIC RESPIROMETER,
Rose Polytechnic Inst., Terre Haute, Ind.
R. M. Arthur, and W. N. Hursta.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 242-250. 11 fig, 4 ref.

Descriptors: *Biochemical Oxygen Demand, Sewage, Least squares method, Instrumentation, Water.
Identifiers: *Oxygen uptake, *Automatic Respirometer.

Short term oxygen uptake rates using an automatic respirometer and five-day BOD values were determined on duplicate samples of settled sewage. The amount of oxygen uptake after four and seven hour periods was plotted against the five-day BOD value and lines of best fit determined. The average deviation of five-day BOD from these lines was 21.3 percent utilizing four hour uptake and 15.8 percent utilizing seven hour uptake. These deviations are comparable to the reported accuracy of plus or minus 20 percent for the five-day BOD test. The oxygen uptake curves obtained were investigated and an equation of the form $Y = a + bx + c$ (x sq) was found to best relate oxygen uptake to time. Attempts to correlate the coefficients c or b for a particular sample with the five-day BOD resulted in average deviations of five-day BOD from the line of best fit of 23.8 percent for the coefficient c and 22.0 percent for the coefficient b. (DiFilippo-Texas)
W70-07476

HIGH-RATE DIGESTION CONTROL III-ACID BASE EQUILIBRIUM AND BUFFER CAPACITY,
Georgia Inst. of Tech., Atlanta.
F. G. Pohland.
Proceedings of the Industrial Wastes Conference, 23rd, 1968, p 275-284. 3 fig, 2 tab, 6 ref.

Descriptors: *Equilibrium, *Anaerobic digestion, Acids, Hydrogen ion concentration, Waste water treatment.
Identifiers: *Buffer capacity, Bases, Disassociation.

Many of the products of anaerobic digestion are weak acids or weak bases. It is convenient to characterize the aqueous environment on the basis of acid-base equilibrium using pH as the master variable. Equilibrium expressions are developed which permit quantitative evaluation of primary acid-base equilibria contributing to the pH response within the anaerobic environment; these results are confirmed by experimental results; the results are used to describe the relative condition of the process and the concept of buffer capacity is introduced. Analysis of the equilibria involved indicates that the buffer system of importance to pH control during anaerobic digestion can be represented by the respective disassociations of the monoprotic species, ammonia and acetic acid and the first disassociation steps of the diprotic species, hydrogen sulfide and carbonic acid. Values of pH predicted from equilibria considerations corresponded well with pH observed during the anaerobic digestion of synthetic garbage. Buffer capacity, the inverse slope of the acid-base titration curve, at a certain pH in relation to the rate of evolution, neutralization or removal of acidic or basic products, may be used to predict the probability of change of digestion conditions. (DiFilippo-Texas)
W70-07477

THREE YEARS OPERATION OF AERATED STABILIZATION BASINS FOR PAPERBOARD MILL EFFLUENT,
Packaging Corp. of America, Rittman, Ohio.
Franklyn D. Haynes.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 361-373. 6 fig, 6 tabs.

Descriptors: *Aerobic treatment, *Waste water treatment, Nutrients, Temperature, Biochemical Oxygen Demand, Dissolved oxygen, Cost, Sludge, Chemical Oxygen Demand, Pulp and paper industry, Pulp wastes.
Identifiers: *Aerated lagoons, *Secondary waste treatment, *Waste stabilization, Primary waste treatment, Suspended solids (SS).

Because of problems caused by overloading, the waste stabilization ponds of Packaging Corporation of America were converted to aerated stabilization basins. The treatment now consists of screening and primary settling, aerated lagoons followed by settling lagoons and post aeration before discharge. Ninety percent of the SS and 25 percent of the BOD were removed in primary treatment. With an eleven day detention time, the BOD was reduced from 468 mg/l to 69 mg/l and suspended solids were reduced from 3.2 lb/mg to 2.0 lb/MG in the aeration basins on the average. The settling lagoons further reduced the BOD and SS to 63 mg/l and 1.1 lb/MG respectively. The final discharge, following post aeration, contained an average of 56 mg/l BOD, 3.8 mg/l DO and 1.9 lb/MG suspended solids. During the three years of operation, BOD reduction ranged 69 to 95 percent. Although sampling showed little variation of COD, DO, or SS within an aeration basin, an estimated 720 tons of sludge accumulated in the aeration basins during 1967. The effect of temperature variation and nutrient addition is also discussed. The cost of operation including nutrients and labor but excluding taxes and amortization was 6.4 cent/MG in 1967. (Bishop-Texas)
W70-07478

PRELIMINARY RESULTS OF A NEW APPROACH IN THE AEROBIC BIOLOGICAL TREATMENT OF HIGH CONCENTRATED WASTES,
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Fred M. Welch.
Proceedings of the Industrial Wastes Conference, 23rd, 1968, p 428-437. 8 fig, 2 ref.

Descriptors: *Sewage treatment, *Biomass, Dissolved oxygen, Temperature, Chemical Oxygen Demand, Aerobic treatment, Waste water treatment.
Identifiers: *Rotating biological contactor, *Discs, Revolution speed, Hydraulic loadings.

The Rotating Biological Contactor (RBC) consists of a series of rotating discs which are partially submerged in waste water and, as the discs are rotated, carry a thin film of fluid into contact with air. On these discs a biological film is established and thus the discs act as an aeration mechanism and a mechanism to contact biomass with waste water. A synthetic sewage consisting of dairy solids and nutrients was treated in a two stage RBC system. Various amounts of concentrated synthetic sewage were mixed with tap water to give influent COD values of 500 to 4000 mg/l. Other variables investigated included: hydraulic loading, dissolved oxygen content of the mixed liquor, temperature, solids content of the mixed liquor and disc rpm. BOD reductions of the synthetic waste correlated well with previous results from settled sewage. Increased disc rpm favorably affected the process and this could be due to either increased agitation or increased dissolved oxygen of the mixed liquor. It is concluded that the RBC has a great many operating parameters that allow process variation which makes the RBC suitable for treating a wide range of biodegradable wastes. (DiFilippo-Texas)
W70-07479

DEWATERING PAPER MILL SLUDGE BY VACUUM FILTRATION,
West Virginia Pulp and Paper Co., Covington, Va.
Alan M. Lindsey.
Proceeding of the Industrial Waste Conference, 23rd, 1968, p 438-446. 6 fig, 2 tab.

Descriptors: *Filtration, *Dewatering, *Sludge, Disposal, Design, Filter, Waste treatment costs, Pulp wastes, Sludge treatment.
Identifiers: *Paper mill sludge, Pilot data, Lagooning, Thickener, Trucking.

The problems encountered in the lagoon method of disposal of solids in the Covington Mill since 1955 are discussed. The major problem was the lagoon overflow which created a BOD load on the plant of up to 30,000 lbs/day and a hydraulic load of 2 mgd. It was estimated that the lagoon would be full in three years. Extensive dewatering studies were therefore conducted to evaluate filters, centrifuges and screw presses. The operation and performance characteristics of filters are discussed. Attempts were made to correct various factors such as filter feed solids and cake solids, filter feed solids and filter loading, and cycle time and filter load, but the correlation was poor due to the variability of sludge characteristics. The solid disposal system utilizing vacuum and trucking to a land fill has been in operation at Covington for nearly two years. This system has worked well on all types of sludge that have been encountered, except pulp tailings. Methods for further dewatering and incineration in power boilers have been investigated, but a workable system has not been completely developed. (Shankar-Texas)
W70-07480

LONG TERM AERATION OF KRAFT PULP AND PAPER MILL WASTES,
Riegel Paper Corp., Riegelwood, N.C., Pulp and Paperboard Div.
Marshall T. White.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 447-457. 3 fig, 3 tab.

Descriptors: *Design, *Efficiencies, *Pulp and Paper industry, Biochemical Oxygen Demand, Costs, Industrial wastes, Nutrient requirements, Pilot plants, Pulp wastes, Waste water treatment.
Identifiers: *Aerated lagoons, *Surface aerators, BOD removal, Extended aeration, Oxygen transfer, Secondary treatment, Stream standards.

The Riegelwood paper mill originally produced 200 tons/day of bleached kraft pulp. The original waste treatment facilities consisted of a 230 acre retention basin that permitted storage or the 14 MGD of waste for 39 days. The basin provided satisfactory treatment for only a short time, as the production rate of the mill has increased continuously since its initiation. Stream standards for the Cape Fear River require a minimum DO of 3.0 mg/l. A pilot plant was installed to evaluate the treatability of the mill wastes with supplemental surface aeration. Biochemical oxygen demand (BOD) removals of 84 percent were possible with the pilot plant and laboratory determinations indicated that the waste had an alpha value of 0.7, which was used in designing the treatment system. Fourteen-60 HP aerators were installed and achieved an 88 percent BOD removal efficiency during the summer-fall period. The aerators are not operated during the winter months, when river oxygen resources are sufficient to assimilate the total waste load without treatment. The total cost of the surface aeration system was $260,000 and the annual operating costs are about $56,000. The total cost of all equipment installed to date for monitoring and treating the mill waste is a little over one and a quarter million dollars. Since the installation of the aerator system, there has been a gradual increase in mill production which has increased the volume of waste to about 40 MGD. Fifteen-20 HP aerators were installed to extend the aeration time. Through the use of additional aerators, the basin is expected to provide adequate treatment for a waste volume up to 100 MGD. (Aguirre-Texas)
W70-07481

STABILIZATION OF A LOW SOLIDS CARBOHYDRATE WASTE BY AN ANAEROBIC SUBMERGED FILTER,
Texas Univ., Austin.
Alan H. Plummer, Jr., Joseph F. Malina, Jr., and W. Wesley Eckenfelder, Jr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 462-473. 6 fig, 3 tab, 6 ref.

Descriptors: *Anaerobic bacteria, *Anaerobic digestion, *Waste treatment, Biochemical Oxygen Demand, Chemical Oxygen Demand, Methane, Methane bacteria, Acids, Industrial wastes, Waste water treatment, Carbohydrates.
Identifiers: *Solids retention time, *Anaerobic filter, Detention time.

Four laboratory scale submerged anaerobic filters were operated at various hydraulic loadings. The units were filled with a mixture of Raschig rings and berl saddles giving the filter media a porosity of 65 to 70 percent. Hydraulic detention times of 83, 60, 21 and 13 hours in the units gave organic loadings of 101, 237, 438, and 638 pounds COD per cubic foot per day. Effluent and influent BOD and COD, PH, volume of gas produced, composition of gas produced, alkalinity, volatile acids and solids were monitored. The raw feed had a BOD of 5,200 mg/l and COD of 8475 mg/l. Steady state COD removal efficiencies ranged from 86 percent to 30 percent for the four units while BOD removal efficiencies of 94 percent to 41 percent were observed. Higher loadings gave rise to higher effluent solids, thereby reducing solids retention time to a point insufficient for establishment of a satisfactory microbial environment. Solids retention times ranged from 163 days to 4 days and effluent solids ranged from 455 mg/l to 1855 mg/l. The effluent solids were readily separated by gravity settling. (DiFilippo-Texas)
W70-07482

TERTIARY TREATMENT OF SECONDARY INDUSTRIAL EFFLUENTS BY ACTIVATED CARBON,
Texas Univ., Austin.
Ned K. Burleson, W. Wesley Eckenfelder, Jr., and Joseph F. Malina, Jr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 474-483. 6 fig, 3 tab, 8 ref.

Descriptors: *Activated carbon, *Tertiary treatment, *Industrial wastes, Chemical Oxygen Demand, Adsorption, Activated sludge Waste treatment.
Identifiers: *Langmuir isotherm, Total organic carbon, Refinery waste, Petro chemical waste, Refractory materials.

Effluents from laboratory and plant scale activated sludge reactors were filtered through Whatman Number 42 filter paper. The effluents were from treatment of two refinery and one petrochemical wastes and had COD values and TOC values respectively of 86 and 23 mg/l, 40 and 16 mg/l; and 107 and 33 mg/l, for refinery waste number one. Refinery waste number 2 and the petrochemical waste respectively. Various amounts of activated carbon from the same source but of two different mesh sizes were added to the wastes and agitated for contact times up to 320 hours. While the smaller mesh size exhibited a higher rate of adsorption in the early stages of the tests the removal after 320 hours of contact time was essentially the same. Data indicate that: the bulk of adsorption took place in the first 100 hours of contact time; that activated carbon will remove up to 85% of refractory material expressed as TOC from secondary industrial effluents; and the Freundlich isotherm successfully described the adsorption process in the batch studies. Activated carbon columns were used to treat waste containing 2, 4 dichlorophenol and concentration time profiles from each column recorded. (DiFilippo-Texas)
W70-07483

NEW SECONDARY AERATED STABILIZATION BASINS AT THE MORAINE DIVISION,
Kimberly-Clark Corporation, West Carrollton, Ohio. Moraine Mill.
William M. Laing.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 484-492. 3 tab.

Descriptors: *Pulp and paper industry, Costs, Efficiencies, Industrial wastes, Nutrient requirements, Sludge disposal, Treatment facilities, Waste water treatment, Pulp wastes.
Identifiers: *Aerated stabilization lagoons, BOD removal, DO levels, Primary treatment, Secondary treatment, Surface aerators.

Operating experiences encounted with the aerated stabilization basins treating 5.5 MGD of waste water from the Moraine Mill of the Kimberly-Clark Corporation in West Carrollton, Ohio are described. Production amounts to 280 tons/day of business paper and 125 tons/day of secondary fiber. The normal mill waste effluent is high in mineral content, suspended solids of 200 mg/l and BOD of about 750 mg/l. The treatment facilities include an elaborate primary clarification scheme with sludge dewatering and disposal. Biochemical oxygen demand (BOD) reduction is very high, averaging between 45 and 50 percent. Secondary treatment of the clarified effluent is done in two aerated stabilization basins that provide a 6 day retention time and a minimum of 85 percent BOD removal. In each lagoon are three floating aerators, powered by 60 hp motors. Nutrient is fed to the clarified water between the clarifiers and the basins in the form of phosphoric acid and anhydrous ammonia. Current expansion of the mill will increase production capacity by 50 percent; the addition of a third aerated basin with three additional 75 hp aerators will permit the continued overall BOD reduction of 85 percent or better. (Aguirre-Texas)
W70-07484

RECOVERY AND REUSE OF OIL EXTRACTED FROM INDUSTRIAL WASTE WATER,
Ford Motor Co., Cleveland, Ohio.
Gordon J. Schutt, Charles C. Keil, and Steve J. Holasz.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 493-496. 2 fig.

Descriptors: *Oil wastes, *Oily water, *Waste water treatment, *Cost benefit analysis, *Costs, Water reuse, Industrial wastes.
Identifiers: *Waste oil reclamation.

Two industrial waste treatment plants are maintained to treat the process wastes of the two Cleveland Engine Plants of the Ford Motor Company. The output of these treatment plants consists of clarified water, sludge slurry, and skim oil. The skim oil contained 70% water, and the major cost of disposal was hauling it away. Experimentation with a commercial de-emulsifying agent resulted in complete separation of the emulsified oil and water mixture. The oil recovered was of such good quality that it was reused as a soluble emulsified cutting oil in the Engine Plants. Costs of cutting oil could be reduced from $0.90/gal to $0.16/gal by reuse of the skim oil. Reclaimed oil base coolants last 40-50% longer than virgin oil base coolants. Corrosion inhibition is better also. Machinery stays cleaner with reclaimed oil. New facilities being built will supply the full soluble oil base demand for both Engine Plants. In the new facilities solids will be removed by filtration, rather than gravity settling as was the case in the pilot plant study. (Makela-Texas)
W70-07485

TECHNICAL AND LEGAL CONTROLS FOR THE DISPOSAL OF ANIMAL WASTES,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering.
Raymond C. Loehr.
Proceedings of the Industrial Waste Conference, 23rd, 1968, p 507-519. 2 fig, 5 tab, 21 ref.

Descriptors: *Animal wastes, *Runoff, *Management, *Farm management, *Aerobic treatment, *Water pollution, *Water pollution control, *Water pollution treatment, *Solid wastes, *Legal aspects, Runoff forecasting, Cattle, Hogs, Poultry, Farm wastes.
Identifiers: *Manure, *Agricultural runoff, Anaerobic lagoons.

Several alternatives exist for disposal of animal wastes: (1) land disposal of liquids and solids, (2) solids combustion with land disposal of liquid, and (3) discharge of solids and liquids to receiving waters. All these alternatives are potential sources of water pollution. The quality of treated and untreated animal waste waters, both from a legal point of view and a farmers point of view, are discussed. Animal wastes are normally semi-solid, thus high in BOD, COD, suspended solids, Na, NH3. If rainfall runoff is allowed to mix with the animal wastes, a larger volume of waste will need to be treated. Many states now consider large livestock operations to be industrial processes and require treatment of wastes in such a manner that receiving waters are not harmed by discharge of animal waste waters. Waste water runoff holding ponds are commonly used with intermittent discharge to receiving waters or land disposal. Several processes are used for treatment of animal wastes, the more common being anaerobic lagoons, aerobic lagoons, aerated lagoons, oxidation ditches, or a combination of anaerobic-aerobic treatment. In more arid areas, runoff holding ponds are sometimes satisfactory. Handling and treating animal wastes as a liquid usually involves less labor, less expense, and thus is more commonly found in large livestock operations where concrete pens are found and confinement is practiced. Since liquid wastes require more treatment, handling the animal wastes directly as a semi-solid with land disposal might be a more economic method. (Makela-Texas)
W70-07486

BIOLOGICAL TREATMENT OF A DISTILLERY WASTE,
Kentucky Univ., Lexington.
Carl E. Burkhead, Claude A. Lessigh, and Tad R. Richardson.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 520-527, 3 fig, 4 tab, 12 ref.

Descriptors: *Activated sludge, *Waste water treatment, *Biochemical Oxygen Demand, *Industrial wastes, *Design criteria, Aeration, Lagoon, Design.
Identifiers: *Aerated lagoon, *Extended aeration, Distillery wastes, (Bardstown, Kentucky).

This investigation showed that distillery wastes could be treated using an aerated lagoon system. Sources, volumes, and characteristics of the distillery waste were presented. Results from an extended aeration pilot plant showed BOD removals varied from 77-97 percent with an average removal of 91.5 percent. Corresponding BOD loadings were from 3-27 lbs/day/1000 cuft with an average loading of 18. An aerated lagoon system based on a design flow of 150,000 gpd and a BOD of 550 mg/l was selected. The maximum allowable operating temperature was set at 110 F. A polishing pond was included in the design so as to improve winter operation. Oxygen transfer and mixing requirements for the aerated lagoon system were provided by mechanical aerators. A total construction cost of $71,000 was estimated. (Galwardi-Texas)
W70-07487

POULTRY PROCESSING WASTES TREATMENT EXPERIENCE IN AERATED PONDS,
Griffith (Llewellyn B.), Falls Church, Va.
C. C. Griffith.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 537-539, 1 fig, 1 ref.

Descriptors: *Poultry, *Waste treatment, *Waste water disposal, *Aeration, *Costs, *Cost sharing, Cost allocation, Cost analysis, Circulation, Lagoons, Industrial wastes, Waste water treatment.

Identifiers: Aerated ponds, Aerobic treatment, Aerated lagoons, Parshall Plume, Circulators.

The poultry waste emanating from the Sterling Processing Corporation of Oakland, Maryland, is treated in two aerated ponds in series. Production is seasonal, being double in the fall. Daily production in the fall is approximately 200,000 lbs live weight per day with a BOD loading of 1600 lbs per day average maximum and 1900 lbs per day peak maximum. Aeration is supplied by positive displacement blowers discharging through fixed circulators in the two ponds. Waste water circulates at 1 fps and has an average retention time of 14 hours. Biochemical oxygen demand (BOD) in the first pond is reduced from an influent concentration of 800-1000 mg/l to 70-100 mg/l, and to less than 30 mg/l in the second pond. Suspended solids and COD reduction are commensurate with BOD reduction. E. Coli (MPN) was reduced in excess of 99.9% at a chlorine dosage of 20 lbs per day. Sterling Processing's waste load accounts for about 60% of the total waste load within the Garrett County Sanitary District. Original plans called for an activated sludge unit to treat the wastes from three communities and Sterling, with Sterling paying $194,000 of the $690,000 total cost, and an operating cost of $14,000/yr. Voters in the District rejected the facility, and Sterling was forced to build its own facilities at a cost of $84,000, for a savings of $109,000. (Makela-Texas)
W70-07488

A ROLE FOR REVERSE OSMOSIS IN A NEUTRAL SULPHITE SEMICHEMICAL PULP AND PAPERBOARD MILL,
Green Bay Packaging, Inc., Wis.
William R. Nelson, and Gerald O. Walraven.
Proceedings of the Industrial Waste Conference, 23rd, 1968. pt 2, p 540-549, 2 tab, 5 fig, 4 ref.

Descriptors: *Industrial wastes, *Pulp and paper industry, *Reverse osmosis, Water reuse, Treatment facilities, Sulfite liquors, Water pollution control, Pulp wastes, Waste water treatment, Tertiary treatment.

Water uses and waste water treatment schemes for a 210 ton per day semichemical pulp and paperboard mill are described. After laboratory studies have demonstrated the feasible application of reverse osmosis for the treatment of excess white-water and kraft thickener effluent, a full-scale plant will be expected to produce an effluent which is practically color free, odor free and nonfoaming from feed water containing 0.5 percent dissolved solids. Eighty-five to 90 percent of the total dissolved solids are expected to be present in the concentrate when the reverse osmosis unit operates between 5 and 15 gallons/sq.ft./day. A scheme for providing almost complete water reclamation and reuse within the plant is described. (Sorber-Texas)
W70-07489

THE MANAGEMENT AND DISPOSAL OF DAIRY MANURE,
Washington State Univ., Pullman. Coll. of Engineering.
Donald E. Proctor.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 554-566, 8 fig.

Descriptors: *Animal wastes, Management, *Farm management, *Dairy industry, *Algae, *Cattle, Slurries, Spraying, Activated sludge, Farm wastes.
Identifiers: *Manure, Anaerobic lagoon, Aerated lagoon.

Dairy manure can be either an asset or a liability depending on the farmer's management policies. Increased demand for livestock-derived products, specialization of farm operations, confinement rearing, cheaper chemical fertilizers, urban sprawl and farm area encroachment, and higher aesthetic standards are all facets of the changing problem of manure disposal. Of these changes, confinement rearing is most significant. Not only is the manure concentrated into a smaller area, but rainfall runoff can treble the waste volume to be handled. Two Washington State dairy farms received Federal Demonstration Project Grants, the Knott Dairy Farm of the Washington State University receiving a grant from the FWPCA, and the Monroe Honor Farm of the State of Washington Institutional Farm Industries receiving a grant from the Public Health Service. The two-year project at the Knott Dairy Farm proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure, (2) demonstrate the comparative capabilities and economics of activated sludge and naturally aerated lagoons for second stage treatment and (3) determine whether it is possible and practical to reduce the nitrogen and phosphorus content of the treated effluent by algae propagation and harvesting for use as cattle feed. The Monroe Honor Farm project proposed to (1) demonstrate the capabilities of an anaerobic lagoon for first stage treatment of dairy manure. (Makela-Texas)
W70-07491

TREATMENT OF A SLAUGHTERHOUSE WASTE USING ANAEROBIC AND AERATED LAGOONS,
Burns and McDonnell Engineering Co., Kansas City, Mo.
Allan H. Wymore, and James E. White.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 601-618, 3 fig, 14 tab.

Descriptors: *Efficiencies, Biochemical Oxygen Demand, Design criteria, Hogs, Organic loading, Waste water treatment, Industrial wastes.
Identifiers: *Aerated lagoons, *Anaerobic lagoons, *Slaughterhouse wastes, Diffused air tubing, Field surveys.

An extended aeration plant treating the wastes from a hog slaughterhouse located in Iowa Falls, Iowa was overloaded 230 percent of the original organic design load and 275 percent of the original hydraulic design load. A study indicated that it would be advantageous to abandon the existing treatment facilities and construct a new plant consisting of a lagoon system utilizing both anaerobic and aerated lagoons. The design kill rate was 3800 hogs per day. The lagoon system was preceeded by an air-flotation tank which averaged 34.9 percent BOD removal, hence, the design BOD discharged to the lagoon system was 5450 lbs/day. Two anaerobic lagoons, operated in parallel, received the effluent from the air-flotation tank and result in the removal of approximately 60 percent of the applied BOD at a loading rate of 15 lbs BOD/1000 cu. ft. The effluent from the anaerobic lagoons is discharged to two aerated lagoons operated in series and using 52,000 ft of diffused air tubing. The final effluent from the aerated lagoons has a BOD of about 35 mg/l which represents a 95 percent BOD removal within the aerated lagoon. The entire system is removing 99 percent of unfiltered BOD and 96.8 percent suspended solids. (Aguirre-Texas)
W70-07492

APPLICATION OF COMPUTERIZED ANALYSIS TO COMPARATIVE COSTS OF SLUDGE DEWATERING BY VACUUM FILTER AND CENTRIFUGE,
Quirk, Lawler and Matusky, New York.
Thomas P. Quirk.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 691-709, 11 fig, 6 tab.

Descriptors: *Sludge, *Dewatering, *Costs performance, Efficiency design, Sludge treatment, Sewage treatment.
Identifiers: *Centrifuge, *Vacuum filter, Moisture removal.

Analyses are presented which recognize the intermediate nature of the dewatering operation and provide for acceptance of the various limitations and controls imposed by upstream pretreatment and downstream final disposal. System analysis approach is taken to allow for both generalization and specificity needs to be served. Comparison between centrifuge and vacuum filter costs is made based on system analysis procedure for both general and specific installations. The procedure employed involves the following steps: (1) development of performance model for the unit operation and/ or the equipment under study, (2) use of field performance data to define the constants in the performance model, (3) development of a cost model for the unit operation and/ or equipment under study, (4) relation of cost of performance and, (5) use of computer facilities to execute the cost of performance relationship for any condition desired. Comparative cost analysis for a continuous sludge production rate of 750 lb/hour for the case studied favor the centrifugal dewatering. (See also W69-00338) (Shankar-Texas)
W70-07494

TRICKLING FILTER THEORIES,
Rice Univ., Houston, Tex.; and Ethyl Corp., Baton Rouge, La.
A. W. Bush, and G. A. Hughmark.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 766-771, 3 fig, 1 tab, 7 ref.

Descriptors: *Mathematical models, *Trickling filter, *Biological treatment, Dissolved oxygen, Computer program, Waste water treatment.
Identifiers: *Cell model, *Laminar model, Glucose, Inclined plate, Molecular diffusion, Eddy mixing, Aerobic, Anaerobic.

A mathematical model called cell method has been developed to simulate the biological treatment of a glucose solution on an inclined plate. The model considers consumption of glucose at the biological surface on the plate and diffusion of glucose and oxygen through the liquid film to the biological surface. A computer program was used for the cell method. The program was tested with several values of the consumption rate to attempt to match the experimental data for glucose, based upon carbon analysis as a function of distance down the inclined plate for an anaerobic run comparison of data calculated from the model and experimental data indicates that the liquid film flow is not laminar. The computer program is therefore revised to include a representation of eddy mixing. Good agreement is then obtained between calculated and experimental glucose concentrations. Aerobic runs were also made at various flow rates. (Shankar-Texas)
W70-07495

THE NITROGEN AND PHOSPHORUS REQUIREMENTS FOR THE BIOLOGICAL OXIDATION OF WASTEWATERS,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
Bernard R. Sachs, and Waldron D. Sheets.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 806-831, 18 fig, 2 tab, 21 ref.

Descriptors: *Activated sludge, *Biochemical oxygen demand, *Nitrogen, *Phosphorus, *Sugar beets, Industrial wastes, Waste water treatment.
Identifiers: *Optimum levels, *Requirements, *Treatment efficiency, Biological oxidation, Pilot-scale palnt, Warburg respirometer.

An investigation was conducted to determine (1) the optimum levels of nitrogen and phosphorus necessary to achieve the greatest oxidation in the shortest time for sugar beet waste water and (2) the best form of nitrogen to add to the waste water for such achievement. The average annual sugar consumption in the U. S. is nearly 10 million tons, one-third of which was produced from sugar beet in 1965. The study was divided into three phases. The initial phase dealt with the rate of oxidation, measured by a Warburg Respirometer, resulting from the addition of nitrogen and phosphorus compounds; the second phase was the operation of a batch and continuous flow pilot-scale activated sludge process for treatment of sugar beet wastes; and the concluding phase studied the response to

addition of the various nitrogen forms. The addition of nitrogen increased the rate of oxidation up to a four-day oxidation period. Optimum nitrogen levels ranged from 70 mg/l to 23 mg/l nitrogen for one to three-day oxidation periods. No additional phosphorus was needed since the rate was unchanged upon addition of phosphorus. Ammonium sulfate ($34 per ton) was the most effective as well as the most economical supplement material used. In a continuous flow activated sludge treatment with one-day aeration time, there was better than 80 percent reduction in consumed oxygen. (Aquirre-Texas)
W70-07496

EFFECT OF BORON ON AEROBIC BIOLOGICAL WASTE TREATMENT,
Delaware Univ., Newark.
Shankha K. Banerji, Brian D. Bracken, and B. M. Garg.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 956-965, 3 fig, 4 tab, 22 ref.

Descriptors: *Boron, *Toxicity, *Activated sludge, Chemical oxygen demand, Detergents, Surfactants, Waste water treatment.
Identifiers: Biological processes, Sludge synthesis, Settling characteristics.

Boron concentrations have been increasing in waste waters. High boron levels may be harmful to the operation of biological processes. Sludge was acclimated to a glucose and yeast substrate. This sludge was used to seed batch activated sludge units run on glucose and yeast substrate to which various amounts, zero to 200 mg/l, of boric acid or sodium borate was added. In almost all the systems having a boron addition the COD removal rate was lower than the control unit. The removal rate decreased somewhat exponentially with increase in boron concentration. The sludge synthesis coefficient remained practically constant even at high levels of boron. Settling behavior of the sludge was found to be somewhat adversely affected at concentrations greater than 100 mg/l of boron. Present levels of boron in domestic and laundry waste waters are low and there seems to be no great problem in biological treatment of such wastes. Adsorption or concentrations of boron on sludge may create situations where the toxicity may be significant. (DiFilippo-Texas)
W70-07498

REMOVAL OF ORGANIC COLLOIDS BY MICROFLOTATION,
Clarkson Coll. of Technology, Potsdam, N.Y.; and Cincinnati Univ., Ohio.
E. Alan Cassell, Alan J. Rubin, Howard B. Lafever, and Egon Matijevic.
Proceedings of the Industrial Wastes Conference, 23rd, 1968. p 966-977, 9 fig, 19 ref.

Descriptors: *Flotation, *Froth flotation, Wastewater treatment, Color, Coagulation, Bacteria, Aluminum tertiary treatment, Foam separation, Water reuse.
Identifiers: *Microflotation, pH, Frother, Collector.

Microflotation is a foam seperation process which, like conventional seperation, required the addition of a collector and a frother. Microflotation produces a thin, relatively dry foam and very low gas flow rates of fine bubbles are required. A laboratory batch system was used to investigate removal of several types of bacteria and removal of color from water. Lauric acid was used as the collector and ethaneol or isopropanol as the frother. Microflotation was studied at various pH values and with and without the additon of aluminum salts for coagulation. Data showed that E. Coli and materials which cause organic color are not removed in the absence of aluminum salts while under the same condition A. aerogenes and B. cereus are only partially removed. In the presence of aluminum salts all three types of bacteria and material which cause organic color are removed, the optimal pH being approximately 7.2. Requirements for successful microflotation include; maintenance of optimum pH and coagulant dosage; addition of proper collector and frother; and maintenance of an adequate gas flow for rapid seperation while not disturbing the flow. (DiFilippo-Texas)
W70-07499

REMOVAL OF ORGANIC REFRACTORIES BY REVERSE OSMOSIS,
Washington State Univ., Coll. of Engineering, Pullman.
Paul J. Bennett, Shyamala Narayarian, and Ervin Hindin.
Proceedings of the Industrial Waste Conference, 23rd, 1968. pt 2, p 1000-1017, 4 tab, 5 fig, 7 ref.

Descriptors: *Reverse osmosis, *Organic compounds, *Membranes, Tertiary treatment, Membrane processes, Industrial wastes, Effluents, Efficiencies, Water reuse.

A laboratory-scale reverse osmosis unit was employed to determine the efficiency of modified cellulose acetate membranes to reject organic refractories. The unit was operated at 100 atmospheres and flux between 5 and 25 gallons/sq.ft./day with varying feed concentrations. Pure solutions of 19 different chemical species were examined as well as 7 different mixtures. Rejections ranged between 14 and greater than 99.9%. In addition several species were mixed with trickling filter and activated sludge effluents resulting in reductions of between 21.4 and greater than 98% depending upon initial concentrations and operating conditions. Reverse osmosis is capable of producing a product water extremely low in organic matter excepting those organic compounds which have a vapor pressure higher than water when in solution or a dispersion. (Sorber-Texas)
W70-07501

DECISION FACTORS--SEPARATE INDUSTRY OR JOINT MUNICIPAL WASTE TREATMENT,
Weston (Roy F.), Inc., West Chester, Pa.
Francis A. Sanders.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1021-1028, 4 ref.

Descriptors: *Waste treatment, *Industry, Wastes, Costs, Toxicity, Industrial waste, Sewage treatment.
Identifiers: *Decision factors, *Community Sewage system, Laws, Legal implication.

The advantages and disadvantages are discussed to both industry and communities concerning the question of whether an industry should treat its own wastes or send them to a community sewage system. There are definite economical advantages to industry in the latter case, since capital and operating costs can be eliminated as an industry expense for the waste facilities constructed and operated by the community. Good relations are maintained when agreements can be reached to the satisfaction of the community and industry. Various factors which play a very important part in making the decisions are discussed. These include availability of land for industries to build treatment facilities, type of wastes, pretreatment requirements, the amenability of industrial wastes to biological treatment, toxicity, effect of certain wastes upon sewer material and the distance of the industry from community treatment plants. Futher the method of financing, statues, laws, legal implications, and equitable service charges should all be considered in making the final decision. (Shankar-Texas)
W70-07502

PACKAGE SLUDGE COMBUSTION FOR INDUSTRIAL WASTE TREATMENT PLANTS,
Dorr-Oliver, Inc., Stamford, Conn.
Robert J. Sherwood.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1029-1038, 8 fig, 2 tab.

Descriptors: *Industrial waste, *Treatment, *Sludge disposal, Centrifugation, Waste treatment.
Identifiers: *Combustion, *Scrubber, *Hydrocyclone, FS Disposal-Type CR.

The package sludge combustion system, called the FS Disposal-Type CR, is designed to receive a thickened degritted raw sludge, about three to five per cent total solids concentration and produce an inert ash. The following features make the FS Disposal-Type CR system well suited to meet industrial sludge disposal problems: (1) Combustion of 200 lbs of solids per hour can be accomplished in an area approximately 15 feet x 20 feet; (2) Start up and shut down costs are minimal, as the time required is less than 30 minutes; and (3) Three premounted sections provide for easy field connections and set up. The sludge combustion package consists of (1) A MercoBowl Centrifuge which concentrates the sludge from 4 percent to approximately 22 per cent solids; (2) A sludge combustion unit which operates at 1700 degree F; (3) A scrubber-dehumidifier; and (4) A hydrocyclone for ash concentration. The combustion unit works on the following principles. Concentrated sludge solids are sprayed radially towards the intensely heated walls of the combustion chamber. High velocity air preheated with combustion gases from the fuel burner is introduced tangentially into the cylindrical combustion chamber imparting a centrifugal force to the sludge particles giving them the necessary residence time required for combustion. (Galwardi-Texas)
W70-07503

THE TREATMENT OF PHENOLIC WASTES,
Emschergenossenschaft, Essen (West German).
Hans J. Wurm.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1054-1073, 20 fig, 2 tab, 8 ref.

Descriptors: *Industrial wastes, *Treatment, *Phenols, *Activated sludge, *Solvent extractions.
Identifiers: *Ifawol-dephenolization process, *Benzene-caustic-dephenolization process, *Phenosolvan-dephenolization process.

Various methods of removing phenols from industrial wastes are described. In 1966 the coke-oven plants and gas works of the Federal Republic of Germany produced over 65 million cu m of phenolic wastes with about 400 mg/l phenols. About 8,000 tons of phenols have been removed each year by the 21 dephenolating plants of Emschergenossenschaft and Lippeverband. By 1972 the present quantity of phenols in the Emscher River of about 10 mg/l will be reduced, by biological treatment, to less than 1 mg/l. Treatment of phenolic wastes consists of either recovery or destruction of phenols with recovery being only applied to quantities of water greater than 10 cu m/hr and phenol concentrations of at least 2 g/l. Phenol concentrations of 2,200 to 2,600 mg/l have been reduced to 30 mg/l using the benzene-caustic-dephenolization process and subsequent alterations. The phenosolvan-dephenolization process utilizing isopropyl ether as the solvent in a nine stage extractor has produced effluents containing less than 10 mg/l phenol. The ifawol-dephenolization process has obtained 99% removal of phenols from wastes containing 4 g/l phenol. The solvent used in this process is a residue product obtained during the extraction of higher alcohols from olefins. Texts have shown that the activated sludge process can remove phenols from a concentration of 10 mg/l to less than 1 mg/l with an aeration time of 90 minutes. (Galwardi-Texas)
W70-07504

ENVIRONMENTAL MANAGEMENT AT A MAJOR PETROCHEMICAL FACILITY,
Resource Engineering Associates, Inc., Stamford, Conn.
Robert N. Rickles.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1074-1088, 8 fig, 11 tab.

Descriptors: *Industrial wastes, *Treatment, *Deep well pumping, *Management, *Waste water treatment, *Control systems, Facilities.
Identifiers: *Acetaldehyde, Houston, Texas.

The program undertaken by the Celanese Corporation in the planning and development of a major new petrochemical facility located in the Bay Port Industrial Development at Houston, Texas, was discussed. Contact was made with all control agencies and discussions were held with their personnel with regard to the intended program. The results from an extensive air pollution survey of the site were presented. An evaluation of the aquatic environment of nearby Taylor Bayou was also conducted. The first unit constructed on the site was an acetaldehyde unit having a capacity of 175 million lbs/yr. The basic concept utilized for pollution prevention centered around minimization and control. Thus, it was necessary to have absolute control over all water streams in the developed plant minimized to prevent air pollution. (Galwardi-Texas)
W70-07505

FUNGUS CONTROL IN VACUUM FILTERS,
Metropolitan Sanitary District of Greater Chicago, Ill.
Gregory A. Ettelt, Evan N. Sakellariou, and Donald W. Harper.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1120-1133, 15 fig, 9 ref.

Descriptors: *Treatment, *Activated sludge, *Fungicide, Dewatering, Sewage treatment, Waste water treatment.
Identifiers: *Vacuum filters, *Blinding, *Fungal growth, Filter cloth, Caustic treatment, Fungal inhibition, Spray treatment.

Chronic blinding was investigated of vacuum filters as a result of fungal growth rather than particulate entrapment. Blinding of vacuum filters at Southwest plant resulted in loss of solids yield. Investigations showed that several types of fungi were involved and that blinding originated within the filter cloth. Backing deposits and increases in iron content within the deposits were found to be not relevant to the occurrence of blinding. Chemical treatment for cleaning the blinded filter have the disadvantage that the production decreases during the first stages of blinding and the loss of filter availability for about eight hours required for the cleaning treatment. Use of concentrated hydrochloric acid followed by two percent caustic was found to be more efficient in restoring filtration to blinded areas. An organotin-quaternary amine mixture completely inhibited fungal growth at 75 mg/l concentration in skae-culture tests. Continuous spray addition of the fungicide demonstrated adequate promise by preventing blinding of the filter cloth. (Shankar-Texas)
W70-07506

BIOLOGICAL TREATMENT OF ORGANIC PHOSPHORUS PESTICIDE WASTE WATERS,
Ryckman, Edgerley, Tomlinson and Associates, Inc., St. Louis, Mo.
C. Lue-Hing, and S. D. Brady.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1166-1177, 8 fig, 2 tab, 6 ref.

Descriptors: *Activated sludge, *Biological treatment, *Design criteria, *Industrial wastes, *Organo-phosphorus pesticides, Pilot plants, Waste water treatment.
Identifiers: *Pesticide industry, *Source control, Biological acclimation, Biological toxicity, Field studies, Laboratory studies, Phosphate removal, Waste water characterization.

The waste waters generated by Chemagro's manufacturing operations resulted in a water pollution problem which is unique among industrial wastes in general, although perhaps characteristic for the pesticide industry. The nature of the waste waters produced the following pollutional characteristics: (a) high BOD concentrations; (b) high COD concentrations, (c) moderate suspended solids concentrations; (d) biological toxicity; and (e) high organic phosphate concentrations. The ideal solution to any waste problem is the elimination or avoidance of the waste at the source. Chemagro's efforts in source control are aimed at the following areas: housekeeping, recovery/reuse, process modifications, segregation of waste, and pretreatment. Field and laboratory studies showed that the organic phosphorus component was amenable to chemical treatment, the BOD exerting component was biodegradable and could be treated by the activated sludge process under proper conditions of biological sludge acclimation. Since the biological responses to shock loading were very erratica and unpredictable, the decision was made to further study the treatment system in a field pilot plant installation. The pilot plant data indicates that the oxygen utilization rate of the sludge is 75 mg/l per hr at a MLSS concentration of 3270 mg/l. The biological removal of the dissolved organic material as measured by BOD was effective, since 90 to 98 percent reductions were realized during the pilot plant operation. (Aguirre-Texas)
W70-07507

STABILIZATION POND TREATMENT OF SLAUGHTER-HOUSE WASTES,
Japan Public Nuisance Lab., Tokyo.
Isamu Horasawa.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 1178-1185, 3 fig, 6 tab, 9 ref.

Descriptors: *Hogs, *Lagoons, Algae, Organic loading, Waste water treatment, Water utilization, Industrial wastes, Oxidation lagoons.
Identifiers: *Japan, *Slaughterhouse wastes, Experimental studies, Lagoon design, Scale-up factors, Waste composition.

Wastes discharged from about 900 slaughterhouses in Japan, which kill approximately 6,000,000 animals per year, require a high degree of treatment to prevent water pollution and aesthetic nuisances of blood color and offensive odor. This experimental study was directed toward the use of the stabilization pond process by small slaughterhouses. The average water consumption by slaughterhouses located throughout Japan is about 848 liters per hog unit and the average BOD loading per hog unit is 1.255 kg. Four experimental stabilization pond units were run both in the laboratory and exposed to outside winter conditions. The BOD loading on the units ranged from 47 to 239 mg/l.These studies showed that, within the limits of laboratory scale testing, BOD loadings up to 100 mg/l (100 g/m2) can be tolerated without distinct aesthetic nuisance. The dominant algae in the ponds was Chlorella. The response to variation in weather conditions appeared to be dependent to some extent upon the BOD loading of the unit. The more heavily loaded units showed an indifferent response to weather change. Biochemical oxygen demand (BOD) loading for stabilization ponds is reported to range from less than 10 mg/l up to 150 mg/l depending on the dgreee of treatment required. (Aguirre-Texas)
W70-07508

THE CHARACTERISTICS AND POLLUTIONAL PROBLEMS ASSOCIATED WITH PETROCHEMICAL WASTES, SUMMARY REPORT,
Engineering-Science, Inc. Texas, Austin.
Ernest F. Gloyna, and Davis L. Ford.
Available from the Clearinghouse as PB-192310, $3.00 in paper copy, $0.65 in microfiche. Water Pollution Control Research Series, February 1970. 98 p, 17 tab, 13 fig, 120 ref. FWQA Program No. 12020---2/70, Contract No. 14-21-461.

Descriptors: *Oil wastes, *Waste water treatment, *Effluents, *Separation techniques, *Operating costs, Oily water, Chemical wastes, Organic wastes, Water pollution treatment, Industrial wastes, Effluent streams, Separation techniques, Water quality, *Operating costs, Emulsions, Water pollution effects, Oil industry, Water reuse, Reclaimed water, Waste water disposal, Cooling water, Biological treatment, Adsorption, Flotation, Oil-water interfaces, Solvent extractions, Coagulation, Oxidation, Oxidation lagoons, Biodegradation, Activates sludge, Trickling filters, Waste dilution, Biochemical Oxygen Demand, *Injection wells.
Identifiers: Inorganic wastes, Oil pollution effects, *Petrochemical wastes, Gravity separation, Waste stabilization ponds.

Each of the major processes developed by the industry should be studied with the objective of evaluating the trends in plant locations, effects onareawide water quality, and treatment requirements. Since there will be no significant changes in petrochemical feedstocks, the patterns of feedstock usage should be monitored and major changes evaluated in terms of the water use and water reuse requirements, potential pollution problems, and product development. Because the main contribution to environmental pollution from the petrochemical industry emanates from process waste streams, comparative cost analyses should be made on typical recycle (feedstock) practices and on associated waste water treatment requirements. A comprehensive and coordinated evaluation program should be developed specifically for standardizing the characterization techniques of wastewater containing complex and undefinable petrochemical and related wastewater constituents. Large volumes of wastewater could be reused within the plants with varying degrees of treatment; most wastewaters require some form of primary product recovery and treatment, oil removal, settleable solid removal, and reduction in the organic content. Master plan for in-plant wastewater collection should include facilities to segregate process waste from less contaminated streams. Problem areas in the physical, chemical and biological treatment processes, as well as disposal methods, are listed. A detailed and basic study should be initiated to evaluate the cost of treating wastes from single plants or process streams with combined wastes from several plants.
W70-07511

ELECTROPHORETIC WATER CLARIFICATION TECHNIQUES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
William M. Lyle, and Howard A. Hiler.
Water Resources Bulletin, Vol. 6, No. 2, p. 193-208, March-April, 1970. 13 fig, 13 ref. OWRR Project A-009-TEX (1).

Descriptors: Electrophoresis, Separation techniques, Water purification, Waste water treatment.
Identifiers: Suspended pollutants.

Only very recently has a limited amount of attention been focused directly on electrophoresis as a method for improving water quality. This approach has been proposed primarily as a method for removal of suspended colloidal material, although solutes can also be removed by this method. Electrophoresis is defined as the movement of charged suspended particles in a dc electric field. Several electrophoretic clarification systems and techniques have been developed and evaluated primarily for removing colloidal clay from suspension. The methods should apply equally well to any negatively charged particulate matter. Design for optimal clay removal efficiency and operating cost efficiency has been based upon previous theoretical results and upon modification of the combination filter-electrophoresis model for Bier. These systems and techniques along with the theoretical developments leading to their design are discussed. Results and conclusions are given for tests that have been concluded concerning the feasibility or practicality of these electrophoretic clarification systems for commercial use. These are viewed in light of various limiting factors such as electrical conductivity of the medium, quality of water desired, colloid concentrations and electrophoretic mobility of the suspended materials.

W70-07512

REMOVAL OF TRACE ORGANICS FROM WATER BY ADSORPTION ON COAL,
Virginia Polytechnic Inst., Blacksburg. Dept. of Sanitary Engineering.
Paul H. King.
Completion Report, March 1970. 6 p. OWRR Project A-015-VA (2).

Descriptors: Water pollution control, *Coal, Phosphates, *Adsorption, *Waste water treatment, *Phosphorous compounds, Pesticides.
Identifiers: *Trace organics, Resistant organics.

Laboratory investigations were conducted to determine the sorptive capacity of several grades of coal for selected biochemically resistant organic materials and for several phosphorus containing compounds. Both batch and continuous flow column studies were employed and data was obtained for uptake kinetics and sorptive capacity at equilibrium. Three representative pesticides, lindane, parathion and chlorisopropyl carbamate, and selected orthophosphate, metaphosphate and polyphosphate compounds were utilized. Significant differences in sorption with differing coals and solutes were noted. Some studies were also conducted for comparative purposes with activated carbon. The distribution of organic and phosphorus containing materials between the aqueous phase and the solid material is described by appropriate adsorption isotherms. (See also W70-05470)
W70-07559

5E. Ultimate Disposal of Wastes

SANITARY LANDFILL LOCATION STUDY.
Stark County Regional Planning Commission, Canton, Ohio.

Report available from Clearinghouse as PB-187 807, $3.00 in paper copy, $0.65 in microfiche. Stark County Regional Planning Commission, Canton, Ohio, Sept 1969. 84 p, 5 fig, 18 ref. Project No Ohio P-238 HUD.

Descriptors: *Landfills, *Waste disposal, *Hydrogeology, Water pollution control, Surveys, Leaching, Geology, Groundwater movement.
Identifiers: Stark County (Ohio).

Twenty-seven strip mine sites in Stark County, Ohio were analyzed as to their suitability for a sanitary landfill. Twelve of the 27 sites are recommended. The 12 sites recommended for a sanitary landfill are analyzed according to a list of geohydrological criteria. Each of the 12 sites is classified according to its major geohydrological characteristics and the types of waste materials acceptable to each class. Each site is described and analyzed on an individual basis according to: (a) location, land use and zoning, (b) size and ownership, (c) classification, suitability, and life expectancy, (d) potential reuse of the completed landfill, and (e) generalized analysis of geologic materials. (Knapp-USGS)
W70-07193

SOIL SYSTEMS FOR LIQUID WASTE TREATMENT AND DISPOSAL: ENVIRONMENTAL FACTORS,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
For primary bibliographic entry see Field 05D.
W70-07348

WATER -- 1969.
For primary bibliographic entry see Field 05G.
W70-07380

ULTIMATE DISPOSAL OF WASTE WATER: A PHILOSOPHICAL VIEW,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
Robert B. Dean.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 1-4, 1969. 4 p.

Descriptors: *Waste disposal, *Water pollution control, Waste water (Pollution), Sewage, Waste treatment, Byproducts, Water reuse, Economics, Ultimate disposal.

A proper understanding of ultimate disposal shows that there is no storage place that can be considered ultimate disposal for everything. The best that we can do is to put the individual elements back where they were before they started their long journey to the sewage treatment plant. This means carbon dioxide back via the atmosphere to the immense buffer system of the ocean, nitrogen back to nitrogen gas in the atmosphere, calcium back to the land or stones, etc. The ocean is ultimate disposal for sodium chloride, but it is not ultimate disposal for DDT or mercury salts. (See also W70-07380). (Knapp-USGS)
W70-07381

ULTIMATE DISPOSAL OF WASTES TO SOIL,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. C. Routson, and R. E. Wildung.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 19-25, 1969. 7 p, 40 ref. AEC Contract AT (45-1)-1830 and FWPCA Contract No 14-12-508.

Descriptors: *Waste disposal, *Soils, *Landfills, *Soil disposal fields, Nutrients, Toxicity, Pesticides, Inorganic compounds, Poisons, Radioactivity, Absorption, Adsorption, Water reuse, Soil chemical properties, Soil chemistry, Organic matter.
Identifiers: Disposal in soil.

The soil is a suitable medium for the ultimate disposal of wastes which will either be transformed to innocuous forms or recycled and removed as agricultural crops. Thus, ultimate soil disposal should be limited to major plant nutrient elements, radionuclides with practical half-lives, and biodegradable organic materials. Efficient soil sorption should not be the sole criterion used in evaluation of the soil as a medium for waste disposal. For example, heavy metal solutions can be decontaminated by soil percolation, but many are toxic to plants even in small quantities. The rate and extent of recyclization or dissipation of soil amended inorganic or organic wastes will be dependent upon the properties of the waste and of the soil. (See also W70-07380). (Knapp-USGS)
W70-07383

DISPOSAL OF EFFLUENTS FROM DESALINATION PLANTS,
Dow Chemical Company, Freeport, Tex.; and Texas A and M Univ., College Station.
M. A. Zeitoun, W. F. McIlhenny, and R. O. Reid.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 156-166, 1969. 11 p, 9 fig, 2 tab, 14 ref. Office of Saline Water Contract No 14-01-0001-1161.

Descriptors: *Ultimate disposal, *Brines, *Desalination plants, Desalination processes, Heated water, Thermal pollution, Water pollution control, Diffusion, Dispersion, Mathematical models, Hydraulic models, Jets, Waste water disposal.
Identifiers: Desalination plant effluents.

Heat, salinity, and copper are the critical pollutional parameters of desalination plant effluents. The dispersion of the dense effluent into sea water was studied in a laboratory model. An approximate analytical solution of the differential equations governing the flow and density distribution for an upwardly projected dense jet was obtained. The proportionality of the average height of dense jets to the flow conditions and density differences was established experimentally. The distribution of dye concentration across the jet was found to be Guassian, with two distinctly different slopes identifying a middle region of upward flow, surrounded by an outer region of downward flow. Turbulent diffusion coefficients inside the jet have been calculated. This information is being used for the design of outfall systems from desalination plants. (See also W70-07380) (Knapp-USGS)
W70-07391

DEEP-WELL DISPOSAL OF STEEL MILL WASTES,
National Steel Corp., Portage, Ind. Midwest Steel Div.
C. D. Hartman.
Journal Water Pollution Control Federation, Vol 40, No 1, p 95-100, Jan 1968. 6 fig, 2 tab.

Descriptors: *Sludge disposal, *Injection well, *Acids, *Steel, Industrial wastes, Sludge treatment, Lagoons, Groundwater, Geology, Costs, Filtration, Disposal, Waste disposal.

The large accumulation of sludge as well as the increasing production of sludge at the Midwest Steel Mill forced investigation of an altemate disposal method to its overtaxed sludge lagoons. Deep-well injection was considered and geological investigation showed that a water-filled sand stone formation approximately 2,500 feet thick was located about 2,000 feet beneath the Midwest plant site. The injection tube is a 3-inch fiberglass pipe which is resistant to the waste pickle acid. Before injection the acid is filtered to eliminate particles larger than 0.5 microns. The new process has reduced sludge accumulation by 70%. A flow of 75 gal/min has been operating for 18 months with no pressure required. The monthly waste disposal costs have been reduced from $33,000 for lime neutralization to $5,200 for the deep-well injection. (Hancuff-Texas)
W70-07447

DALE V BEDAL (IMPLIED EASEMENT FOR SEWAGE DISPOSAL).
For primary bibliographic entry see Field 06E.
W70-07647

5F. Water Treatment and Quality Alteration

FACTORS INFLUENCING THE HERBICIDAL EFFICIENCY OF MCPA AND MCPB IN THREE SPECIES OF MICRO-ALGAE,
University of Strathclyde, Glasgow (Scotland). Dept. of Biology.
R. C. Kirkwood, and W. W. Fletcher.
Weed Research, Vol 10, No 1, p 3-10, 1970. 2 fig, 3 tab, 12 ref.

Descriptors: *Chlamydomonas, *Algae, *Herbicides, Pesticides, Chlorella, Respiration, Phosphorus, Toxicity, Radioisotopes, Inhibition.
Identifiers: *Chlorinated herbicides, MCPB, MCPA, Chlamydomonas globusa, Chlorella pyrenoidosa, Stichococcus bacillaris, Undissociated molecules, Algal growth.

The relative herbicidal effectiveness of MCPA (4-chloro-2-methylphenoxyacetic acid) and MCPB (4- (4-chloro-2-methylphenoxy) butyric acid) was appraised by using as test plants three spp of unicellular algae. The algae were grown in nutrient solutions of pH 6.5 in 10-1 aspirators. The herbicides were C-14-carboxyl-labelled. MCPB inhibited growth, respiration, and phosphorus uptake more than MCPA and was toxic at the minimum concentration of 0.0025 moles. The enhanced herbicidal effect of MCPB coincided with its increased absorption. Both herbicides inhibited phosphorylation. Optimum uptake of herbicides was at pH values favoring movement of undissociated molecules. (Wilde-Wisconsin)

W70-07255

AUTOMATIC COOLING TOWER CONTROL,
Magna Corp., Santa Fe Springs, Calif.
H. Fietler, and C. R. Townsend.
Chemical Engineering Progress, Vol. 65, No. 5, p 63-67, 1969.

Descriptors: *Thermal pollution, *Cooling towers, *Control, Cooling, Evaporation, Automatic control, Recirculated water, Water quality, Dissolved solids, Water quality control.

The effect of heat discharged from electric steam power plants on rivers is discussed. Comparison between once-through condenser cooling systems and cooling tower systems is made from the thermal pollution standpoint. Potential problems in the latter system can be minimized by reducing the amount of bleed-off water put to waste and by reducing the concentration of chemicals added to the cooling water. The tower controller is an automatic system for controlling tower water scale and corrosion treatment by measuring and controlling within present limits, the water's pH, TDS, inhibitor level and corrosion rate. The major functional and operational concepts utilized in the tower controller were presented. Generalized economic data showed that labor and chemical savings could pay for the equipment in one year while reducing both thermal and chemical pollution. (Novotny-Vanderbilt)
W70-07322

TOXICOLOGICAL ASPECTS OF WASTEWATER RECLAMATION--A PRELIMINARY REPORT,
California State Dept. of Public Health, Berkeley. Sanitation and Radiation Lab.
For primary bibliographic entry see Field 05C.
W70-07350

5G. Water Quality Control

NEUTRALIZATION OF HIGH FERRIC IRON ACID MINE DRAINAGE,
Federal Water Quality Administration, Norton, W. Va. Norton Mine Drainage Field Site.
For primary bibliographic entry see Field 05D.
W70-07149

OPTIMAL RESERVOIR RELEASES FOR WATER QUALITY CONTROL,
Federal Water Quality Administration, Annapolis, Md. Chesapeake Technical Support Lab.; and Michigan Univ., Ann Arbor. Dept. of Sanitary and Water Resources Engineering.
Norbert A. Jaworski, Walter J. Weber, Jr., and Rolf A. Deininger.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA3, Paper 7361, p 727-742, June 1970. 16 p, 8 fig, 3 tab, 18 ref, append.

Descriptors: *Reservoir operation, *Water quality control, *Mathematical models, *Optimization, Flow augmentation, Systems analysis, Water quality, Water storage.
Identifiers: Reservoir release planning.

A general mathematical model for determining optimal flow release sequences for water quality control from multiple reservoir systems is presented. The model defines an optimal release sequence which provides either the 'best quality of water' or the 'least cost of reservoir storage' for a given streamflow at a particular point in the system. Using the converging-branch multistage system of dynamic programming, the flow release problem is decomposed into a sequence of subproblems or stages. At each stage or decision point, which represents a confluence of two regulated streams, optimal release sequences are obtained by an efficient enumeration process. The flow release model incorporates formulations for BOD, DO, temperature, and physical relationships for streamflow, velocity, and depth. The facility of examining intermediate solutions at individual stages and the elimination of the need for continuous differential return functions are two of the principal features of the model. (Knapp-USGS)
W70-07150

A BIBLIOGRAPHY OF BOOKS ON THE ENVIRONMENT -- AIR, WATER AND SOLID WASTES,
Toledo Univ., Ohio. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 10.
W70-07190

SANITARY LANDFILL LOCATION STUDY.
Stark County Regional Planning Commission, Canton, Ohio.
For primary bibliographic entry see Field 05E.
W70-07193

RESEARCH DEVELOPMENT AND DEMONSTRATION PROJECTS, Division of Applied Science and Technology.
Federal Water Quality Administration, Washington, D.C.

Available from the Clearinghouse as PB-192 091, $3.00 in paper copy, $0.65 in microfiche. FWQA Report, April 1, 1970. 337 p. FWQA Project 10000---4/70.

Descriptors: *Industrial water, *Water pollution control, Waste water treatment, *Water reuse, *Water pollution treatment, Industries, Water quality, Water requirements.
Identifiers: Industrial pollution control, Municipal pollution control, Agricultural pollution control, Mining pollution control.

A total of 331 information sheets were compiled in the following descriptive categories: Municipal-pollution control technology (88); Industrial-pollution control technology (112); Agricultural-pollution control technology (26); Mining-pollution control technology (44); Other-sources-of-pollution control technology (36); and Water resources planning and resources data (25).
W70-07230

PROBABALISTIC CONSIDERATIONS IN WATER QUALITY MANAGEMENT,
Illinois Univ., Urbana.
Ben B. Ewing.
Proceedings of the Water Resources Seminars 1968-1969, University of Delaware, Newark, December 1969, p 65-79. 4 fig, 1 tab, 10 ref.

Descriptors: *Probability, *Water quality control, *Stochastic processes, *Biochemical Oxygen Demand, *Dissolved oxygen, Markov processes, Ohio River.
Identifiers: Streeter-Phelps equation.

The results of studies concerned with the application of the theories of probability to water quality management were reported. Previous investigations on the development of a stochastic model for water pollution problems based upon a Markov Chain model and on the recognition of the random nature of dissolved oxygen response to biochemical oxygen demand loads or to stream discharge were cited. Specifically, the classical work of Streeter and Phelps done on the Ohio River, concerning biochemical oxygen demand (BOD) relationships was described and expanded. Dissolved oxygen relationships were also analyzed and examples of the work were given. It was concluded that further research is needed to apply the laws of probability to the Streeter-Phelps and modified Streeter-Phelps equations and that the application of probabilistic models should be extended to describe the response of a stream to other pollutants such as radioactive materials, dissolved materials and trace organic compounds. It was proposed that the real key to the development of further probabilistic concepts in water quality management is the availability of large data banks of field data. (Kriss-Cornell)
W70-07240

OPTIMIZATION: THEORY AND PRACTICE,
Heriot-Watt Univ., Edinburg (Scotland).
For primary bibliographic entry see Field 06A.
W70-07251

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

TREATMENT OF MINE DRAINAGE BY INDUSTRY IN PENNSYLVANIA,
Pennsylvania Dept. of Health, Harrisburg. Div. of Mine Drainage.
For primary bibliographic entry see Field 05D.
W70-07346

PROCEEDINGS FLORIDA'S ENVIRONMENTAL ENGINEERING CONFERENCE ON WATER POLLUTION CONTROL.

Available from College of Engineering, Univ. of Florida, Gainesville, Fla. - Price $5.00. Florida Univ. Engineering and Industrial Experiment Station Bulletin Series 135, Vol 24, No 3, March 1970. 168 p. OWRR Report A-999-FLA (3).

Descriptors: *Water pollution control, *Florida, Eutrophication, Waste treatment, Waste disposal, Water quality, Lakes, Estuaries, Streams, Monitoring, Water management (Applied), Urbanization, Pesticides, Environmental effects, Water law, Water quality act, Planning, Cities.
Identifiers: Water quality conference.

The Proceedings of a conference held to discuss water pollution control in Florida includes papers by engineers and scientists from all levels of government and from industry and universities. A review of water pollution problems was made as they relate to streams, lakes, estuarine and coastal waters, and the underground waters of the State. Problems of discharging inadequately treated wastes into the usable aquifers of the State, the eutrophication of fresh-water lakes, including the classic case of Lake Apopka, the degradation of streams, and continuing change in ecosystems of our estuarine and coastal waters are discussed. Methods for controlling water pollution include the physical, chemical, and biological aspects of stream monitoring, basin management as a means of water pollution control, control of pollution in estuarine water, advanced waste treatment techniques for nutrient removal, control and removal of pesticides, ecological management as a means of water pollution control, and preservation and restoration of lakes. Reviews of federal, state and local water pollution legislation, as well as regional planning as a means of water pollution control, were presented. (Knapp-USGS)
W70-07371

QUALITY ASPECTS OF FARM WATER SUPPLIES.
Victorian Irrigation Research and Advisory Services Committee, Melbourne (Australia).

Department of National Development, Australian Water Resources Council Publication, Canberra, 1969. 45 p, 1 fig, 8 tab, 5 ref, 4 append.

Descriptors: *Water quality, *Irrigation water, *Domestic water, *Stock water, Water resources, Water supply, Surface waters, Water chemistry, Mineralogy, Groundwater.

Identifiers: Queensland (Australia), Water quality requirements.

Criteria for suitability of water for farm uses are given in a report intended for practical use by farmers. Uses for which quality aspects are listed include irrigation, stock, domsestic, dairy, spray mixing, and concrete making. Although the discussion includes much information specific to the water problems of Queensland, Australia, there is enough of general interest for use anywhere. The quality of a water supply is judged by the amounts of dissolved and suspended materials which are invariably present. Thus, in an absolute sense, high quality in a water is associated with low amounts of such materials. However, in practice, quality must always be considered in relation to the intended use of the water, and a supply which is of high quality for one purpose may be of low quality for another. Quality depends in the first place on the source of the water supply. Subsequently, deterioration during storage on the farm may occur and become important in some circumstances. Organic pollution is the most common cause of deterioration in the quality of waters held in dams, wells, and tanks, and is of concern mainly where the water is required for human consumption. Occasionally, waters held in dams or troughs may deteriorate as a consequence of high evaporative losses and become unsuitable for irrigation or stock because of the increased concentration of soluble salts. (Knapp-USGS)
W70-07375

WATER -- 1969.

Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, 1969. 315 p.

Descriptors: *Ultimate disposal, *Water pollution control, *Water pollution treatment, *Conferences, Waste water treatment, Desalination, Water reuse, Injection wells, Soil disposal fields, Radioactive wastes, Eutrophication, Water management (Applied), Economics, Oily water.
Identifiers: Waste management symposium.

A symposium collection presents 43 papers on the general subject of ultimate disposal of wastes or pollution control. The topics include injection well practices, soil disposal-fields, radioactive waste management, disposal to bodies of water, thermal waste disposal, quality standards, water reuse, waste management, pollution surveys, water pollution treatment, economics of waste management, waste treatment technology, desalination, eutrophication, and oil spill control. (See also W70-07381 thru W70-07393). (Knapp-USGS)
W70-07380

POLLUTION IN THE MISSISSIPPI RIVER,
Federal Water Pollution Control Administration, Chicago, Ill.; and Federal Water Pollution Control Administration, Dallas, Tex.
For primary bibliographic entry see Field 05B.
W70-07384

THE LOUISIANA STREAM CONTROL COMMISSION'S WATER QUALITY STANDARDS AND PROGRAMS FOR THE LOWER MISSISSIPPI RIVER,
Louisiana Stream Control Commission, Baton Rouge.
Robert A. Lafleur.
In: Water - 1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 51-52, 1969. 2 p.

Descriptors: *Water quality control, *Legislation, *Standards, *Louisiana, Water utilization, Water quality, Water pollution control.
Identifiers: Louisiana water quality standards.

The standards and programs for control of the quality of water in the lower Mississippi River are described. In addition, the development of these standards by the Louisiana Stream Control Commission is discussed. Water quality standards for the Mississippi River as well as for all streams in Louisiana were developed in accordance with present uses, anticipated uses, and approximately 8 yr of water quality monitoring data. The recognized uses are: potable and industrial supplies; navigation; limited noncontact recreation; propagation of aquatic life, including shellfish; sport and commercial fishing; irrigation; and the carriage of treated municipal and industrial waste. Consideration was also given to the fact that there will be significant increases in the use of the Mississippi River for potable supplies, industrial supplies, navigation, and irrigation. (See also W70-07380). (Knapp-USGS)
W70-07385

FREEPORT SULPHUR COMPANY'S POLLUTION CONTROL PROGRAM (SPECIAL REFERENCE TO OFFSHORE),
Freeport Sulphur Co., Belle Chasse, La.
Frederick G. Deiler.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 53-63, 1969. 11 p, 16 fig, 2 tab, 2 ref.

Descriptors: *Water pollution control, *Waste water disposal, *Monitoring, *Water quality, *Louisiana, Water analysis, Water chemistry, Sampling, Sulfur, Sulfur compounds, Brines, Saline water, Sea water, Aquatic environment, Aquatic microorganisms.
Identifiers: Sulfur mining, Frasch process.

Freeport Sulphur Company operates five mines in the Gulf Coastal area of Louisiana. At each, the Frasch process of mining is used, necessitating the constant removal of cooler formation water at the flanks of the dome. This waste water, known as bleedwater, totals millions of gallons per day. The Company employs a program of surveillance to assure that the waste disposal is satisfactory and harmless to aquatic life, and that the quality and quantity of the discharge is consistent with the provisions stipulated in the Stream Control Commission permits. The program of surveillance employs routine water sampling for chemical analyses, accompanied by physical measurements. Comprehensive quarterly surveys are conducted at all locations, and these include chemical, physical, and biological measurements but feature the biological parameter. Methods and instruments used to obtain water samples for chemical analyses, sampling gear, and other instruments used in the program are fully described. (See also W70-07380) (Knapp-USGS)
W70-07386

OIL SPILLAGE CONTROL,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
W. H. Swift, C. J. Touhill, and P. L. Peterson.
In: Water-1969, Chemical Engineering Progress Symposium Series 97, Vol 65, published by American Institute of Chemical Engineers, New York, p 265-273, 1969. 9 p, 10 ref.

Descriptors: *Oily water, *Water pollution control, *Water pollution treatment, Biodegradation, Chemcontrol, Aquatic environment, Aquatic habitats, Water pollution effects.
Identifiers: Oil spillage control.

The current state of technology of prevention and control of major oil spillage on water, the restoration of the shore face and waterfowl, and the effects of oil pollution and defensive measures on aquatic life are reviewed, with emphasis on the control aspects including surveillance and prediction of slick movement, chemical treatment of slicks (collection and dispersion), biodegradation of oil in the ocean, booming, burning, skimming, and the treatment and disposal of recovered slicks. Procedures are recommended for oil spillage control, and research needs are identified. (See also W70-07380) (Knapp-USGS)
W70-07392

THE SCIENTIFIC APPROACH TO THE PROBLEM OF OIL POLLUTION,
For primary bibliographic entry see Field 05C.
W70-07416

DISPERSAL OF OIL SLICKS IN PORTS AND AT SEA,
Standard Oil Company of New Jersey.
For primary bibliographic entry see Field 05C.
W70-07417

PARAFFIN FOR OIL POLLUTION OF THE SEA,
Campsa's Central Lab., Madrid (Spain).
E. Castellanos.
International onference on Oil Pollution of the Sea, Rome, p 239-241, Oct 7-9, 1968.

Descriptors: *Water pollution control, Oil wastes, *Oily water, Water quality control, *Water pollution treatment.
Identifiers: *Paraffin, Oil pollution.

When breaks occur in the tanks of tankers, oil spillage can be avoided by solidifying the petroleum with paraffin. Using a small boat, melted paraffin can be projected into polluted ports daily and collected when solid masses form. Oil from marine catastrophes can be solidified by projecting paraffin from the heated tanks of a tanker and can then be collected with dragnets. Paraffin is advantageous because it has a great affinity for oil and transforms the oil into a solid that is easily collected. Paraffin, is relatively inexpensive because it is an excess refinery product. (See also W70-07411) (Harbert-Washington)
W70-07418

BOLLINGER V MUNGLE (WELL POLLUTION; NEGLIGENCE IN CONSTRUCTION AND INSTALLATION OF GAS TANKS).

175 SW2d 912-917 (Mo Ct App 1943).

Descriptors: *Missouri, *Wells, *Water pollution, *Gasoline, Seepage, Land, Land tenure, Legal aspects, Judicial decisions, Damages, Groundwater, Storage, Underground storage, Storage tanks, Repairing, Water wells.
Identifiers: *Nuisance.

Plaintiff brought suit against defendants for damages caused by contamination of a well on her land. One of the defendants had constructed a gasoline pump and underground tank on another defendant's land adjacent to plaintiff. After construction, gasoline began to appear in plaintiff's well. Plaintiff based her suit on negligence of the defendants. The trial resulted in a verdict against one of the defendants but the court sustained a motion for a new trial because of an insufficiency of evidence to establish negligence. Plaintiff appealed, contending that she did prove negligence, but that in any event the pollution constituted a nuisance by defendant and proof of negligence was not necessary. The court of appeals affirmed the trial court. Plaintiff based her action on negligence and could not change her theory to nuisance on appeal. In the trial she failed to carry the burden of proof either by showing negligence on the part of defendant in construction and installation of the tank or failure to remedy or repair its defects. She did show contamination of the well with gasoline but the probative value of this was insufficient to establish defendants' negligence. (Duss-Florida)
W70-07424

ENERGETIC ENFORCEMENT OF INDUSTRIAL WASTE ORDINANCES,
Metropolitan Sanitary District of Greater Chicago, Ill.

For primary bibliographic entry see Field 06E.
W70-07490

SCOTTISH RIVER PURIFICATION BOARDS,
Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 06E.
W70-07566

SQUAW ISLAND FREIGHT TERMINAL INC V CITY OF BUFFALO (ACTION TO ENJOIN THE POLLUTION OF A RIVER BY SEWAGE DISPOSAL).

273 NY 119, 7 NE2d 10-18 (1937).

Descriptors: *New York, *Water pollution, *Sewage disposal, *Cities, Navigable rivers, Judicial decisions, Legal aspects, Banks, Boundaries (Property), Ownership of beds, Fresh-water, Riparian rights, River beds, River flow, Islands, Dredging, Self-purification, Sewers, Outlets, Drainage system, Natural flow doctrine, Competing uses, Administration, Municipal water, Reasonable use, Relative rights, Damages, Permits, Water pollution sources, Navigation, State governments.

Plaintiff brought suit to enjoin defendant city from committing a permanent, continuing trespass by emptying its sewage into the Niagara river and thus causing pollution of plaintiff's land. Plaintiff owned a portion of an island in the river and thirty acres of underground land upon which they had performed dredging operations under federal licenses. Defendant had state legislative authority to dispose of sewage into the river. The appellate court, in answering certain questions propounded by the lower court and in affirming judgement for plaintiff, found that while riparian owners are not entitled to have tidal waters pass their land free of pollution, the pollution must not result in a direct trespass or nuisance to the property or the riparian owners. The authority to dispose sewage was not authority to commit a direct trespass. Defendant's contention that plaintiffs were contributorily negligent in that their dredging caused the sewage to be drawn to their land was rejected. (Barnett-Florida)
W70-07604

ELMORE V INGALLS (COAL MINE POLLUTION).
17 So 2d 674-677 (Ala. 1944).

Descriptors: *Alabama, *Water pollution, *Coal mine wastes, *Natural flow doctrine, Judicial decisions, Riparian rights, Water pollution sources, Coal mines, Mining, Industrial water, Reasonable use, Relative rights, Riparian land, Water utilization, Impaired water quality, Streams, Running waters, Degradation (Stream).

Plaintiff constructed his home downstream from defendant's coal mining operation. Evidence showed that by conducting coal washing operations on the stream banks defendant had substantially impaired the quality of the water. The court held that every riparian proprietor has an equal right to the stream flow through his land in its natural state, although each is entitled to the reasonable use of the water for domestic, agricultural or manufacturing purposes. Recognizing that the public interest favoring industry prevented liability for slight inconveniences or occasional annoyances to those downstream, the court held that the water could not be so polluted as practically to destroy or greatly impair its value to the lower riparian proprietor. Plaintiff's complaint was held to have stated a cause of action. (Douberley-Florida)
W70-07607

DRAINAGE--SANITARY DISTRICTS (STRUCTURE, FORMATION AND ADMINISTRATION).
For primary bibliographic entry see Field 04A.
W70-07618

DRAINAGE - SANITARY DISTRICTS (WASTE DISPOSAL; ACQUISITION AND USE OF PUBLIC PROPERTIES; CONDEMNATION; SEWAGE TREATMENT).
111 Ann Stat ch 42, secs 283, 284, 289, 291, 292 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage districts, *Sewage districts, *Waste disposal, Public rights, Administration, Right-of-way, Water supply, Local governments, Governments, Legislation, Water management (Applied), Water policy, Water law, Drainage, Condemnation, Easements, Cost repayment, Eminent domain, Legal aspects, Facilities, Sewage, Waste treatment, Damages.

The trustees of any sanitary district are empowered to dispose of sewage and control water quality in the district through the use of the facilities of the district and, by agreement, the facilities of other districts. The trustees must prevent contamination of lakes resulting from sewage discharge. No district may discharge sewage into Lake Michigan unless the treatment thereof meets the requirements of state and federal law. When no agreement may be reached upon the terms under which one sanitary district may use the facilities of another, the right to use may be required by condemnation, with compensation as provided by the court. Sanitary districts are empowered to extend their facilities along, under, upon and across highways, streets, and public ground, but without incommoding the public use thereof. Subject to approval by the Governor and public rights of commerce and navigation, districts may construct facilities in, along, or upon lands owned by the state beneath public waters. Damages to private property caused by district activity must be compensated before payment of any other debt. The district may acquire public property, but must restore it to its former usefulness as soon as practicable. (See also W70-07618). (Dye-Florida)
W70-07621

WATER SUPPLY (POLLUTION ABATEMENT).
Pa Stat Ann tit 35, secs 691.601-691.701 (1964), as amended, (Supp 1970).

Descriptors: *Pennsylvania, *Pollution abatement, *Water pollution control, *Public health, Legislation, Water pollution sources, Public rights, Water supply, Sewage, Municipal wastes, Industrial wastes, Sewage treatment, Relative rights, Regulation, Governments, Remedies, Local governments, Legal aspects, Adjudication procedure.

Suits to abate pollution of any waters of Pennsylvania may be instituted in law or equity in the court of common pleas in Dauphin County or in any county in which the polluted water flows. Reasonable time may be permitted for the abatement of the pollution. A mandatory preliminary injunction may be issued where public health is endangered. Summary proceedings under the provisions of this act may be brought before any magistrate, alderman or justice of the peace in the county affected or in the county where the offense occurred. An injunction may be issued against any municipality or person even though there are other contributors to the pollution. Records of applications and proceedings are open to public inspection. A reasonable fee may be required upon filing an application. All rules and regulations established by the board or the Secretary of Health prior to this act are to continue in effect unless otherwise modified. Appeals may be taken to the court of common pleas, Dauphin County. The Commonwealth may act to abate any pollution even after a penalty has been collected. (Hubener-Florida)
W70-07623

SWIFT AND CO V PEOPLES COAL AND OIL CO (LIABILITY FOR UNDERGROUND OIL SEEPAGE).
186 A 629-635 (Conn 1936).

Descriptors: *Connecticut, *Oily water, *Underseepage, *Pollution, Judicial decisions, Oil, Seepage, Damages, Oil industry, Storage tanks, Subsurface drainage, Underflow, Underground streams, Percolating water, Subsurface waters, Underground, Leakage, Percolation, Water rights, Water pollution sources, Groundwater, Groundwater movement, Permeability, Legal aspects.

Plaintiff sued defendant oil company for damages resulting from oil seepage into plaintiff's cellar. Dye tests showed that water percolated from defendant's property into plaintiff's cellar, and since there was a considerable amount of free oil on defendant's property the court found that to be the source of oil on plaintiff's premises. The court held that the absolute right a landowner has to use underground waters does not carry with it a right to make that water unuseable for others. A landowner's rights are restricted when he knows or should know that his use of his land will cause injury to another. The pollution of subterranean waters was held to be a nuisance without a showing of negligence. The rule that removed liability for pollution brought to another's lands by subterranean currents was overruled. Although he leased the property to the oil company, defendant landowner was also held liable because he renewed the lease to defendant oil company without abating the known nuisance. (Douberley-Florida)
W70-07631

JACKSON V UNITED STATES PIPE LINE CO (LIABILITY FOR UNDERGROUND OIL SEEPAGE).
325 Pa 436, 191 A 165-166 (1937).

Descriptors: *Pennsylvania, *Oily water, *Pipelines, *Leakage, Judicial decisions, Oil, Oil industry, Subsurface drainage, Water pollution sources, Pipes, Closed conduits, Metal pipes, Wells, Artesian wells, Water wells, Inflow, Underground, Groundwater, Water supply, Seepage, Infiltration, Water pollution, Pollutants, Legal aspects.

Defendant operated a pipe carrying oil across plaintiff's property at a higher elevation than plaintiff's water well. Upon discovering substantial amounts of oil in his well, plaintiff sued for damages. The court found that the evidence was sufficient to justify a verdict in favor of plaintiff, even in the absence of direct proof of leakage from defendant's pipe. A section of the pipe that was replaced was found to have holes in it, and subsequent to the replacement the oil content in the well was substantially reduced. The ground sloped downward from the pipe to plaintiff's well, and there were no other possible sources for the oil in the vicinity. An experienced well driller testified that the oil came from the defective pipe line. Under the applicable statute the defendant was held to be liable without a showing of negligence since oil from its pipe was found to have polluted the well. (Douberley-Florida)
W70-07632

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

AQUIFER-STREAM INTERACTION,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02A.
W70-07232

TECHNIQUES FOR EVALUATING LONG-TERM RESERVOIR YIELDS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Augustine J. Fredrich.
Paper presented at ASCE National Meeting on Water Resources Engineering, New Orleans, Louisiana, February 8, 1969. 14 p, 8 fig, 8 tab, 4 ref.

Descriptors: *Reservoir yield, *Streamflow forecasting, *Routing, *Computer programs, Optimization, Estimating, Reservoir operation, Water supply, Safe yield, Probability, Statistical methods.
Identifiers: Reservoir yield forecasting.

The effects of some basic assumptions of simplified methods of reservoir yield forecasting are demonstrated so that techniques may be chosen to produce the desired results with the best expenditure of time, funds, and manpower. The techniques for evaluating long-term reservoir yield may be divided into two general categories: (1) non-sequential methods which generally consider only the quantity of water available; and (2) sequential methods which consider both the quantity of water available and its time distribution. The three factors about which assumptions are frequently made in the simplified techniques are evaporation, seasonal variation in demand, and drought duration. Storage requirements to meet a given yield may be underestimated by more than 40% if evaporation and seasonal variation are ignored when they are actually significant. None of the simplified techniques are capable of accounting for all of the factors which affect the yield in a complex multiple-purpose project. The capability now exists to perform these sequential routings by electronic computer, even in the initial planning phases of a study. Furthermore, these routings may be used with generated streamflow data. (Knapp-USGS)
W70-07234

A MODEL OF RATIONAL COMPETITIVE BIDDING,
Shell Development Co., Modesto, Calif.
Michael H. Rothkopf.
Management Science, Vol 15, No 7, March 1969, p362-373. 1 tab, 20 ref, 1 append.

Descriptors: *Mathematical models, *Optimization, *Bids, *Equilibrium, Profit, Decision making.
Identifiers: *Auctions, *Strategies, Highest-bid-wins, Lowest-bid-wins.

A mathematical model was presented of the bidding process that deals explicitly with the uncertainty of the bidders about the value of the subject of the auction. By dealing with this often ignored factor, the model estimated the equilibrium strategies and profits as a function of the number of bidders, the relative values they attach to the subject of the auction and their accuracy in estimating value. Models were developed for highest-bid-wins and lowest-bid-wins auctions. The solutions obtained were strong equilibrium sets of strategies which consider simultaneously the optimality of the decisions of all bidders. This model might have application in the establishment of pricing and allocation policies for future supplies of water. (Kriss-Cornell)
W70-07235

RECENT ADVANCES IN STORAGE AND FLOODING THEORY,
Office of Naval Research, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-07236

A METHOD OF ALLOCATING FUNDS TO INVESTMENT PROJECTS WHEN RETURNS ARE SUBJECT TO UNCERTAINTY,
Smith (A. O.) Corp., Milwaukee, Wis.
Joel Cord.
Management Science, Vol 10, No 2, p 335-341, January 1964. 3 tab, 8 ref.

Descriptors: *Investment, *Dynamic programming, *Risks, *Constraints, *Return (Monetary), Budgeting, Computers.
Identifiers: Uncertainty.

A method was developed for optimally selecting capital investment with uncertain returns, under conditions of limited funds and a constraint in the maxium average variance allowed in the final investment package. A dynamic programming model was developed which considered a single budgeting period and assumed that the net outlays for any selected project took place during that period. The concepts involved in the analysis were somewhat related to Markowitz's work in the portfolio problem. A practical example was given and a computer used to compute the solutions. Clearly water resource projects often involve capital investment and, because of both hydrologic risk and economic uncertainty, have uncertain returns. This method is therefore applicable to such water resource project planning problems. (Kriss-Cornell)
W70-07238

PROBABALISTIC CONSIDERATIONS IN WATER QUALITY MANAGEMENT,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 05G.
W70-07240

A COMPUTER AIDED DECISION SYSTEM,
Polytechnic Inst. of Brooklyn, N.Y.; and Harvard Univ., Cambridge, Mass.
Robert L. Ferguson, and Curtis H. Jones.
Management Science, Vol 15, No 10, p B 550 - B 561, June 1969. 4 fig, 10 ref.

Descriptors: *Computer models, *Computer programs, *Time, *Management, *Decision making, Design.
Identifiers: Subsystems.

A time-sharing computer model was developed and used to conduct experiments in search of operational answers to key questions that arise with the use of on-line, real-time computer based information systems to augment managerial decision making. The research strategy was formulated to investigate these questions from various vantage points. First, a prototype model was selected to explore the structuring problem of designing and programming. The Massuchusetts Institute of Technology's time-sharing computer facility was used and the program was developed and operated in real-time mode. The computer program provided the scheduler with a range of decision choices running from purely manual systems to fully automatic systems which were closed to the possibility of human intervention. Four subsystems were described: the Physical subsystem, the Information subsystem, and the Simulation subsystem, the Decision subsystem, along with a description of the interaction of the total system. The experiments demonstrated that participants, many devoid of computer backgrounds, could make meaningful use of a sophisticated interactive approach to decision making. The model has numerous potential applications to managing water system networks, reservoirs, water and wastewater treatment facilities, and the like. (Kriss-Cornell)
W70-07241

A SAMPLING STUDY OF THE PROPERTIES OF ESTIMATORS TRANSITION PROBABILITIES,
Connecticut Univ., Storrs; Illinois Univ., Urbana; and Morehead State Univ., Ky.
T. C. Lee, G. G. Judge, and R. L. Cain.
Management Science, Vol 15, No 7, p 374-398, March 1969. 10 tab, 59 ref, 1 append.

Descriptors: *Markov processes, *Probability, *Model studies, *Aggegates, *Simulation analysis, Data collections, Time series analysis, Sampling, Population, Least squares method.
Identifiers: Estimators, Parameters.

A sampling experiment was used to evaluate the performance of alternative estimators employed to estimate the transition matrix for a Markov probability model when only the aggregated data, reflecting the proportion of the sample in each state over a sequence of trials, were known. In addition, the experiments provided some initial information relative to the sampling properties of restricted estimators when time series data were used. Simulation and sampling procedures were used to study the sampling properties of the weighted and unweighted general restricted estimators as they relate to estimating the transition properties in the Markov chain from aggregate time series data (e.g. streamflow data). The first order Markov probability model and the simulation model employed was described in detail. The simulation population parameters were presented for the maximum likelihood, unrestricted and restricted least squares, weighted restricted least squares and minimum absolute deviations estimators. The performance of the alternative estimators were evaluated and the general implication of the sampling experiments were discussed. Some applications of the Markov models and potential areas of application were given. Markov models have been used extensively in analyzing stochastic water resource systems, and the determination of transition probabilities from limited hydrologic records is often a problem. This article addresses itself to a means of solving this problem. (Kriss-Cornell)
W70-07242

A CONCEPTUAL FRAMEWORK FOR URBAN PLANNING MODELS,
Harvard Univ., Boston, Mass. Graduate School of Business Administration.
Maurice D. Kilbridge, Robert P. O'Block, and Paul V. Teplitz.
Management Science, Vol 15, No 6, p B246-B266, February 1969. 6 fig, 1 tab, 68 ref.

Descriptors: *Model studies, *Planning, Urban renewal, Economics, Analysis.
Identifiers: Conceptual framework.

A framework for the analysis of models which have been designed for, or used in, urban physical and economic planning (including urban water resources planning) was presented. The models were distinguished by their basic characteristics, rather than on the basis of their applications. Four basic characteristics wereidentified: (1) the subject of the model; (2) its function; (3) its underlying theory; and (4) its method. Besides providing a conceptual framework for the analysis and development of urban planning models, the conceptual framework served as the basis of a classification scheme which allowed the study and comparison of existing models. Such an analysis was presented as an illustration using the conceptual framework. (Kriss-Cornell)
W70-07243

OPTIMAL DEVELOPMENT OF RESOURCES - A PANEL REPORT.
For primary bibliographic entry see Field 06B.
W70-07244

THE DEVELOPMENT OF A MODEL TO EVALUATE HYDROLOGIC RISK IN A WATER RESOURCE SYSTEM,
Battelle Memorial Inst., Richland, Wash.; and Texas A and M Univ., College Station.
For primary bibliographic entry see Field 04A.
W70-07246

PERIODIC MARKOV PROGRAMMING,
Queen's Univ., Kingston (Ontario). Graduate School of Business.
For primary bibliographic entry see Field 04A.
W70-07249

DAILY STREAMFLOW SIMULATION - DISCUSSION OF ARTICLE BY KIP PAYNE, W R NEUMAN, AND K D KERRI,
Illinois State Water Survey, Urbana.
Krishan P. Singh.
Journal of the Hydraulic Division, Proceedings of ASCE, Vol 96, No HY4, p 1046-1047, April 1970. 1 ref.

Descriptors: *Streamflow, *Simulation analysis, *Flow, *Floods, *Time, Water resources.
Identifiers: *Discussion, *Criticism.

The article 'Daily Streamflow Simulation' by Kip Payne, W.R. Neuman, and K.D. Kerri (July 1969) was discussed. (See W69-09355). The authors were commended for their interesting model of a daily streamflow simulator as a new approach to the problem. However, it was felt that some points needed clarification. Criticism was given of the transformation to normal distribution of the rearranged historical flows and the technique for flood flow frequencies. Also questioned was the use to which such a daily streamflow simulator could be put since it seemed that the time sequence of the monthly or seasonal flow peaks will be destroyed and will reduce the accuracy of response. How the simulator can help in analyzing the response of proposed water resource systems was not readily apparent to the author. (Kriss-Cornell)
W70-07250

OPTIMIZATION: THEORY AND PRACTICE,
Heriot-Watt Univ., Edinburg (Scotland).
Gordon S. G. Beveridge, and Robert S. Schechter.
McGraw-Hill Inc, New York, 1970. 773 p, 200 ref, 3 append.

Descriptors: *Optimization, *Analytical techniques, *Numerical analysis, *Variability, *Application methods, Water resources, Planning.
Identifiers: *Techniques, *Practical aspects, Examples, Problems, References.

A presentation that demonstrated the interrelationships between the various facets of optimization was given. The past decade has seen the explosive growth of a class of mathematical methods known as optimization techniques, many of which have found numerous applications in water resources planning. Much of the development has been at a research level, but now attention is being focused on applications and there is a real need for a more general understanding. This need prompted the preparation of this volume which presented a broad but unified coverage of the fundamentals at an introductory level. It intended to serve not only as the background for a formal course, but designed also to facilite self-instruction. The book was divided into three parts: Part One discussed the organization for optimization, the factors influencing the definition of suitable objectives and their subsequent formulation discussed in detail; Part Two presented the techniques of optimization, i.e., the two basic approaches of analytical and numerical optimization were investigated for functions of a single variable, many variables, and an infinite number of variables; and Part Three examined some practical aspects of optimization with particular attention paid to the decomposition of the more complicated systems. A large number of examples were provided throughout the text as an aid to attaining a working proficiency in applying the concepts introduced. The examples were particularly useful for water treatment and wastewater process analyses. Many problems were included with extensive representative references. (Kriss-Cornell)
W70-07251

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
John M. Wilkinson.
Available from the Clearinghouse as PB-192 118, $3.00 in paper copy, $0.65 in microfiche. Final Project Report, May 9, 1970. 334 p, 104 ref, 2 append. OWRR Project C-1415 (1982) (1).

Descriptors: *Water management (Applied), *Water supplies, *Water utilization, *Water pollution, *Surface water, *Groundwater, *Hydrologic data, Floods, Droughts, Multiple purpose reservoirs, Sediments, Irrigation, Navigation, Hydroelectric power, Desalination, Weather modification, Evapo-transpiration, Re-cycle.
Identifiers: *Water-system simulation, *Channel model, *Areal model, *Quality model, *Data system, *Assessment system, Operational functions, Water accounting system.

A data-analytic-reporting system was defined for preparing periodic national water assessments by the Federal Water Resources Council. This system combines all water data input requirements, the analysis of water uses relative to water supply and its quality, and the reporting of this analysis in physical descriptive and predictive terms by operational simulation of water systems for all subregions and river basins, for present and selected future years. Supply analysis incorporates precipitation, evapo-transpiration, surface storage, streamflow, infiltration, and groundwater storage stochastically. Demand analysis incorporates aggregate and point-source withdrawals, consumptive uses, return flows, channel uses, storage uses, inter-basin transfers and re-cycle stochastically. Quality analysis incorporates biochemical oxygen demand, thermal and dissolved-solids effluent loadings in receiving waters, pre- and post-use treatment and instream quality dynamics in stream-segment models. It was designed as a complete assessment system to reveal water excesses and deficiencies and quality problems by use-point, area and over time. The data system was designed to guide organization for simulation. The analytical system defines program routines, subroutines and algorithms in text, charted program logic, and Fortran variables. The rationale for data and model selection is fully documented and output reporting methods are suggested. A critique of prior assessments is provided.
W70-07326

CONJUNCTIVE USE SYSTEMS ANALYSIS,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
J. Day Harold, and M. Shane Richard.
Available from the Clearinghouse as PB-192 116, $3.00 in paper copy, $0.65 in microfiche. Final Report, June 1, 1970. 118 p, 19 tab, 24 fig, 18 ref, 2 append. OWRR Project C-1080 (1577) (1).

Descriptors: *Conjunctive use, *Water utilization, *Storage, *Systems analysis, *Simulation analysis, *Computer models, Surface-groundwater relationships, Optimum development plans, Water storage, Design, Simulation, Costs, Benefits, Recreation, Aesthetics, Water quality, Cities.
Identifiers: *Hybrid simulation models.

Digital simulation and hybrid simulation models have been developed to test alternative plans for the integrated use of surface and sub-surface storage to augment natural streamflow. Techniques for estimating surface storage recreation benefits and aesthetic losses associated with poor water quality in urban riverine areas were developed and used in the ranking of alternatives along with estimates of system costs and reliability. The results of the effort indicate that the full range of possible combinations of surface and sub-surface storage should be considered to insure the selection of the best possible choice.
W70-07328

THE DYNAMICS OF WATER RESOURCES MANAGEMENT IN AN URBAN ENVIRONMENT,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
Douglas L. James.
Typescript, Spring 1970, 10 p.

Descriptors: *Water resources, *Management, *Institutional constraints, *Urbanization, *City planning, Administration, Water supply, Waste water treatment, Cities, Planning, Flexibility, Environment.
Identifiers: *Water resources management, *Urban environment.

The traditional approach to water resources management for urban areas has been based on the examination of needs and the design of separate facilities for water supply, drainage, and waste water collection and treatment. The complexity and interaction among the separate systems required by a metropolitan area has complicated their management and promoted research interest in developing a methodology for better coordination. However, a more thorough evaluation of the problem reveals the real research need to be more complicated and different in character than the problem in systems analysis suggested by the first superficial glance. Water management relates to the much broader problem of community design; when, where, and in what manner should new urban development take place. Furthermore, the character and needs of areas within the metropolis are constantly changing. The key distinctiveness of urban water management is the imperative for design and operation flexibility. The key research need is to develop new designs, operation procedures, and institutional arrangements to make the flexibility demanded by a dynamic urban community possible. (Davis-Chicago)
W70-07509

OPTIMIZATION OF CONJUNCTIVELY MANAGED SURFACE AND GROUNDWATER RESOURCE BY DYNAMIC PROGRAMMING,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 04B.
W70-07555

LEVELS OF OCCUPATIONAL PRESTIGE AND LEISURE ACTIVITY,
Kentucky Univ., Lexington.
Rabel J. Burdge.
Journal of Leisure Research, Vol 1, No 3, p 262-274, Summer 1969. 6 tab, 14 ref.

Descriptors: Social aspects, Income, Age, Education, Statistical methods, Recreation.
Identifiers: *Occupational prestige, Leisure activity, Chi-square test, Social classes, Urban activities, Sports, Hobbies.

Many sociological variables are related to leisure participation. For instance, people in high income brackets, young age categories, high educational levels, generally have been found to be the most active participants in structured leisure activity. Occupational prestige is the variable used in this study to explain differences in the use of leisure. The author contends that the accruement of rewards--monetary and status--determine the variety of leisure outlets. The North-Hatt Occupational Prestige Scale was used as the empirical method of assigning prestige evaluations to specific occupations. The study contends that for almost every type of leisure activity, the probability is that the participants will come from the middle or upper classes. Such an analysis is useful to the water researcher in predicting demand for outdoor water oriented recreation. It is indicative of the importance of including socioeconomic variables in investigating demand for outdoor recreation facilities. (Loeb-Rutgers)
W70-07567

THE THEORY OF LINEAR ECONOMIC MODELS,
Brown Univ., Providence, R.I.; and Rand Corp., Santa Monica, Calif.
David Gale.
New York, McGraw-Hill Book Co, Inc, 1960. 330 p.

Descriptors: *Linear programming, Competition, Equilibrium, Costs, Income, Prices, Leontief models.
Identifiers: *Linear economic models, *Integral linear programming, Two-person game model, Exchange, Duality, Simplex method, Matrix games, Diet problem, Real linear algebra, Scalar product, Matrices, Linear equation, Inequalities, Degeneracy, Saddle point, Minimax, Von Neumann's expanding model.

The term 'economic model' may be thought of as an abstraction and simplification of a typical economic situation. This volume presents several economic models of interest to those concerned with pure and applied mathematics. The first model presented is that of a linear programming model, which in its abstract formulation is a type of mathematical maximum or minimum problem. Many actual economic situations lead to precisely this problem after the appropriate simplifying assumptions have been made. The two-person game model is also discussed. This too is formulated in an abstract manner, but the significance of the model comes from the fact that it is designed to reflect the essential features of certain games of strategy and thus indirectly certain aspects of economic competition. Other models treated concern patterns of exchange between countries or industries, alternative schemes of production and certain economic equilibrium situations. In each case the models are introduced by describing the economic situation, stating the simplifications to be made, and then giving the abstract formulation. Knowledge of the abstract presentation of such models for use in water research should prove to be quite valuable given the extensive use of mathematical and statistical methods in this area. (Loeb-Rutgers)
W70-07570

IMPLICATIONS OF DYNAMIC MONOPOLY BEHAVIOR,
State Univ. of New York, Buffalo.
Frank C. Jen, and Lawrence Southwick, Jr.
American Economic Review, Vol 59, No 1, p 149-158, March 1969. 10 p, 13 ref.

Descriptors: *Monopoly, Demand, Model studies, Industrial production, Prices, Marginal costs, Costs.
Identifiers: *Dynamic monopoly behavior, *Dynamic models, *Natural monopoly, Duopoly, Strategy, Oligopolistic behavior, Cost curves, Demand curves, Dynamic duopoly model, Imposed monopoly, Collusion, Entry.

The behavior of a monopolist has traditionally been studied via static models allowing only one seller to operate. The authors suggest that a convenient way to study dynamic monopoly behavior is to construct a general dynamic duopoly model from which conditions for various types of monopoly can be derived. This paper constructs such a model and derives the 'maximizing' equation. Section II derives the conditions under which a natural monopoly can exist. The possible production and price paths of a monopoly are discussed. Section III studies the production and pricing strategies of a firm which has a monopoly protection initially and wants to continue the monopoly. Section IV compares the effects of collusion with those of monopoly and studies the implications of this model with respect to oligopolistic behavior. A review of the findings and a discussion of areas for further research is found in Section V. Many water producers in control of a water supply find themselves in a position similar to that of a natural monopolist. As such, this paper may assist understanding of the productive and pricing strategies of such agencies. (Loeb-Rutgers)
W70-07571

LOW FREQUENCY VARIATION IN ECONOMIC TIME SERIES,
Osaka Univ. (Japan); and Pennsylvanis Univ., Philadelphia.
Hatanaka Michio, and Howrey E. Philip.
Kyklos, Vol XXII, No 4, p 752-766, 1969. 15 p, 2 tab, 9 fig, 16 ref.

Descriptors: *Time series analysis, *Statistics, *Economics, Mathematical studies, Gross National Produce, Estimating frequency analysis, Investment.
Identifiers: *Econometrics, *Spectrum-analysis, Statistical significance, Cyclical data, Business cycle, Trend analysis.

A number of investigators have suggested that many economic time series exhibit significant long-run variations about an upward trend as well as short-run business fluctuations. The purpose of this paper is to point out that the conclusion reached in a number of studies, using spectrum-analytic techniques, made to test the theory that long-run variations contribute substantially to the variance of economic time series are false in their findings of a lack of significance for the long-run variations. This paper suggests that while there is some evidence of long swings in economic activity, the problems inherent in the analysis of low-frequency variation made it extremely difficult to ascertain their statistical significance. The use of time series data in the economics of water resource planning makes this article of general interest to the empirical water researcher. (Murphy-Rutgers)
W70-07572

A NOTE ON ESTIMATION OF COBB-DOUGLAS AND CES PRODUCTION FUNCTION MODELS,
Wisconsin Univ., Madison.
Dorothy J. Hodges.
Econometrica, Vol 37, No 4, p 721-725, October 1969. 3 ref.

Descriptors: Estimating, Profit, Competition, Least squares method.
Identifiers: *Estimation, *CES Production Function, Cobb-Douglas Production Function.

Zellner, Kmenta, and Dreze in a recent article specified a Cobb-Douglas production model in which the traditional profit maximization assumption was modified to explicitly recognize the stochastic nature of profits. Assuming that firms maximize the mathematical expectation of profits, the authors found that under conditions of pure competition least square estimation of the production function from cross section data on firms' output and inputs provides consistent estimates of the production function parameters if certain reasonable specifying assumptions are satisfied. The purpose of this note is to point out that use of the Zellner, Kmenta, and Dreze framework with a CES production function will also result in a model which permits consistent estimation of the production function parameters from single equation estimation of the production function relation itself. Section 1 of the note demonstrates this conclusion. Section 2 provides the specification and estimation of a related model for a firm operating as a pure monopolist. This article will be applicable in the water area to estimate water production functions in a CES specification. (Loeb-Rutgers)
W70-07573

ADDITIVE VON NEUMANN-MORGENSTERN UTILITY FUNCTIONS,
Pennsylvania Univ., Philadelphia.
Robert A. Pollak.
Econometrica, Vol 35, No 3-4, p 485-494, July-October 1967. 10 p.

Descriptors: Economics.
Identifiers: *Additive utility function, von Neumann-Morgenstern utility, Ordinal utility function, Strong additive axiom, Weak additive axiom, Log additive.

The von Neumann and Morgenstern utility function is one which ranks situations involving probabilities and as such looks at the problem of risk. Necessary and sufficient conditions for the additivity of ordinal utility functions are well known. In this paper a necessary and sufficient condition for the additivity of von Neumann-Morgenstern utility functions is presented; this condition is summarized in the 'strong additivity axiom.' A 'weak additivity axiom' is introduced, and it is shown that an individual's preferences satisfy this axiom if and only if his von Neumann-Morgenstern utility function is either additive or 'log additive.' The extension of these results to the continuous consumption case is indicated. This article might offer theoretical applications to the water researcher interested in resources allocation and demand behavior under risk. (Author)
W70-07574

AN EXTENSION OF THE NET PRESENT VALUE CONCEPT OF INTERTEMPORAL INVESTMENTS,
Texas Univ., Austin.
William G. Lesso.
The Engineering Economist Vol 15, No 1, p 1-8, Fall 1969.

Descriptors: *Economic evaluation, *Rate of discount, *Benefits, *Costs, *Project planning, Project life, Demand, Investment, Mathematical studies, Risk, Budgeting, Capital.
Identifiers: *Net present value, *Monotonicity, Inflation.

In evaluating investment alternatives which have returns or benefits in future time periods, the method usually used is to determine the net present value of the required investment and future returns, taking cognizance of the time value of money. The usual case is where investments occur in the current time period. This article discusses two important variations where: (1) the required investment may span several time periods; and (2) it may be necessary to consider alternatives which will occur in future time periods. Both of these situations are likely to arise in water resource projects. The author extends the net present value criterion to cover these situations and also shows that it is possible to determine the montonicity of alternatives with constant returns. The net present value concept is thus adopted to a larger class of problems. The widespread use of this concept in the area of water resources makes this article of interest to the water planner. (Murphy-Rutgers)
W70-07575

SALES MAXIMIZATION AND MANAGERIAL EFFORT: NOTE,
State Univ. of New York, Buffalo.
David J. Smyth.
American Economic Review, Vol LIX, No 4, p 633-634, September 1969. 1 fig, 3 ref.

Descriptors: Elasticity of demand, Demand, Profit, Income.
Identifiers: *Sales maximization, *Managerial effort, Firm size, Effort, Output.

This note modifies Baumol's familiar sales maximization model by introducing the assumption that managers trade off the advantages of the increased firm size with the disadvantages of the increased effort involved. With this assumption, equilibrium output occurs with the elasticity of demand greater than unity and accordingly the sales maximization hypothesis cannot be refuted by the observation of an elastic demand with above minimum profits earned. This may prove useful in the water area where, for example, with the assumption made above, sales (visits) maximization is the goal for a manager in charge of an outdoor recreation facility. (Loeb-Rutgers)
W70-07576

SOME STOCHASTIC ASPECTS OF SHIP DESIGN ECONOMICS,
Michigan Univ., Ann Arbor.
Odo Krappinger.
The Engineering Economist, Vol 12, No 3, p 167-181, Spring 1967. 4 fig, 2 ref.

Descriptors: *Risks, Ships, Stochastic processes, Economics, Costs, Income, Probability, Time, Interest rate.
Identifiers: *Stochastic aspects, *Ship design, Design alternatives, Present worth, Freight rate.

Engineering Economy has been described as something of a universal solvent, allowing the engineer to weigh the relative merits of design alter-

natives involving different units. Conversion of the features of design alternatives to costs is in many cases a sufficient tool for this purpose. But there are also situations in which a knowledge of costs alone is not enough to make a rational decision. For example, innovations often bear risks and uncertainties. If an engineer wants to demonstrate to the business manager the economic feasibility of an unconventional design, a description of the involved risks and uncertainties is at least as important as the cost information. Future costs and revenues can seldom be predicted exactly. This does not matter if their expected scatter is small, but when the scatter is relatively large, neglecting the influence of the involved risk and uncertainty may lead to wrong decisions. The author assumes that the reader is familiar with two suggested references on ship design and the fundamentals of probability theory. This study is limited to the investigation of annual compounding and may prove useful in the water area where risks and uncertainity must be accounted for in investment and planning decisions. (Loeb-Rutgers)
W70-07577

RESHAPING GOVERNMENT IN METROPOLITAN AREAS.

New York Committee for Economic Development, February 1970. 83 p.

Descriptors: *Federal government, *State government, *Local government, *Economics, *Government supports, Government finance, Transportation, Water supply, Water pollution, Taxes, Education, Sewage.
Identifiers: *Governmental centralization, *Metropolitan government, Job training, Welfare, Poverty.

This report studies the problem of reshaping urban governments for the purpose of solving some of the problems now faced by most metropolitan areas. Of particular interest to the water researcher is its examination of the relationship between the structure of government and the problems of water supply and water pollution. The economics of financing solutions to metropolitan problems of education, transportation, housing, welfare water pollution and water supply are investigated. The interrelationships between the local, state and federal governments with respect to their tax and revenue structure and present aid systems are analyzed and recommendations are offered. The report calls for a restructuring of metropolitan governments with area-wide institutions for some functions of government while maintaining units of government compact enough to enable the recipients of government services to have some control over their quality and quantity. (Murphy-Rutgers)
W70-07579

6B. Evaluation Process

WATER-RESOURCES MANPOWER--SUPPLY AND DEMAND PATTERNS TO 1980.
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 09A.
W70-07229

OPTIMAL DEVELOPMENT OF RESOURCES - A PANEL REPORT.

Journal of the Power Division, Proceedings of ASCE,Vol 96, No PO1, Proc Paper 7073, p 205-210, February 1970.

Descriptors: *Optimization, *Planning, *Decision making, *Water resources development, *Technology.

The objective of the Panel was to explore the opportunities for optimal planning and operation in the power field as associated with multi-resource, multipurpose planning of the physical elements involved. Among the elements included was water (as well as energy, air and land). With the view of resource use, a consideration of the question of optimal use was divided into three areas. The first, concerned with questions relating to the goals and objectives of resources development, was regarded as an analysis of the highest level of a hierarchy of decisions and included socio-economic issues. The second concerned the decision making process itself so that truly optimal decisions can be reached in the complex situations which characterize practical applications. The third level concerned the technical problems that need solution so that optimal decisions can be reached. Specialized problems noted, which were related to water resources were: environmental changes produced by power development, water quality parameters along a river, reservoir operating policies, flood control capability of a reservoir, and problems associated with fluctuation in river flow rates and reservoir levels. (Kriss-Cornell)
W70-07244

POTENTIAL FOR POLICY CHANGE IN THE RECREATIONAL USE OF DOMESTIC WATER SUPPLY RESERVOIRS,
Southern Illinois Univ., Carbondale, Ill. Dept. of Geography.
Duane D. Baumann.
In: Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), ed. Phillip Cohen, Martha N. Francisco, p 559-569, 3 fig, 28 ref.

Descriptors: *Multiple-purpose reservoirs, *Water quality, *Water treatment, *Viruses, *Bacteria, *Chlorination, Filtration, Flocculation, Sedimentation, Northeast U.S., Texas, Kansas, Illinois, Massachusetts.
Identifiers: *Cognitive dissonance, *Policy change, *Water managers, England, Soviet Union, Far West U.S.

Recreational use of reservoirs is described and analyzed and means of bringing about policy changes outlined. Using available data, it was found that 32 per cent of the communities prohibited all forms of reservoir recreation. Restrictions were heavier in the Northeast and Far West where 61 per cent restricted all recreation; in the remainder of the country, this figure was only 8 per cent. Interviews with 26 water managers in Texas, Kansas, Illinois, and Massachusetts most frequently indicated fear of an increased health hazard and possible deterioration in the quality of drinking water. Studies which have sought to determine the extent of water pollution attributable to recreational activities have concluded either: (1) that recreational activities produce no significant pollution, (2) that recreational activities are a major source of pollution, (3) or that only certain kinds of activities can contribute markedly to the pollution load. Critical review of these studies is given concluding that all forms of recreation can be permitted without increasing risk of water-borne disease. The author argues that chlorination is able to destroy virus if filtration to break down particulate organic matter is practiced. Using Festinger's theory of cognitive dissonance, the author outlines three means by which water managers attempt to reduce dissonance. He concludes that if the demand for water-oriented recreation becomes great enough, water managers will change their cognitions. (Preckwinkle-Chicago)
W70-07287

THE ANALYSIS AND EVALUATION OF PUBLIC EXPENDITURES: THE PPB SYSTEM.
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.

Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., 3 Vol., 1241 p., 1969.

Descriptors: *Economics, *Administration, *Cost analysis, *Decision making, *Government finance, *Resource allocation, Planning, Institutions, Economic feasibility, Benefits, Cost benefit analysis, Planning, Budgeting.
Identifiers: *PPB system, Financial management, Programming, Public expenditures policy.

A compendium of papers in three volumes relative to the PPB system (Planning, Programming, Budgeting system) of the Federal government. Volume I, which is by far the most relevant to water resources, covers the appropriate functions of government in an enterprise system, the institutional aspects affecting efficient public expenditure policy, and some problems of analysis in evaluating public expenditure alternatives. Papers are included by various well known economists from educational institutions as well as agency representatives. Issues covered include many which are of basic importance to water resources, such as externalities, uncertainty, publicly administered prices, income distribution, problems of incentives, constraints, discount rates, multiple objectives and regional impacts. Volume II covers the current status of the PPB system, and Volume III covers the performance of the PPB system, in certain areas and a summary of unresolved issues. The latter two volumes are of less economic importance to water resources mainly because the economic analysis of water resources projects is far more advanced than that of the majority of governmental programs; so that the PPB system utilizes economic analysis rather than creating it. (See also W70-07289 thru W70-07307) (Whipple-Rutgers)
W70-07288

EXTERNALITIES, INFORMATION AND ALTERNATIVE COLLECTIVE ACTION,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
Otto A. Davis, and M. I. Kamien.
The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol. 1, p 67-86, 1969.

Descriptors: *Third party effects, *Economics, *Water pollution, Cost benefit analysis, Resource allocation, Indirect benefits, Economic efficiency.
Identifiers: *Externalities.

One of the reasons why an unfettered market system may fail to serve the public interest is the inability of the market to take into account certain kinds of side effects or externalities. Another reason is the deficiency in quality and quantity of information. The paper deals mainly with the externalities problem. The problem of air and water pollution are employed to illustrate the market failure entailed by side effects or externalities. The ability of a river to assimilate waste is recognized as a natural resource, which should be used. In the case of externalities, the authors point out that a number of means of collective action are available, each of which has its own disadvantages. The methods discussed include solution by prohibition, by directive, by voluntary action, by taxes and subsidies, by regulation, by payment and by direct public action. Some form of cost-benefit analysis is suggested to determine which is applicable in a given situation. (See also W70-07288) (Whipple-Rutgers)
W70-07289

CONSTRAINTS ON POLICY ANALYSIS AND POLICY IMPLEMENTATION IN THE FEDERAL AGENCIES,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
Asher Achinstein.
The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol. 1, p 369-415, 1969.

Descriptors: *Economics, *Constraints, *Federal government, Benefit cost analysis, Legislation, Administration, Transportation, Appropriation, Management.
Identifiers: Program evaluation.

This paper summarizes and provides a critique of views of 20 Federal agencies as to the extent to which the agency use of economic analysis in policy formation and decision is impeded by constraints. The agency replies are given as an appendix. The paper discusses institutional, budgetary, personnel, financing, methodological and statutory constraints. Constraints clearly applicable to water resources programs include the following: (a) reluctance of an agency to study in detail alternatives not currently authorized as a Federal program of that agency, (b) relative difficulty in conducting inter-agency analysis where there is a mutual interest between departments, or between levels of government, (c) high cost of planning, and rigidities and delays in the appropritations process, (d) difficulties of making cost benefit analysis in certain fields. One statutory constraint, namely, a legislative enactment requiring a method of benefit analysis of water transportation improvements which is basically uneconomic. (See also W70-07288) (Whipple-Rutgers)
W70-07290

ON THE DISCOUNT RATE FOR PUBLIC PROJECTS,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
William J. Baumol.
The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol. 1, p 489-503, 1969.

Descriptors: *Economic efficiency, Economics, *Benefit cost analysis, *Interest, *Discount rate, Risks, Program evaluation.
Identifiers: *Opportunity costs, Uncertainty.

After a brief analysis the author states that the correct discount rate for the evaluation of a government project is the percentage rate of return that the resources utilized would otherwise provide in the private sector. However, resources withdrawn from a corporation usually have a higher opportunity cost than those drawn from direct consumer use. Reasons for diversions between industries include taxes, risk and externalities. As regards taxes, government discount rate should be weighted average of opportunity costs from sectors having different tax impacts. Extra returns on account of risk should not be included in opportunity costs; because, although losses are serious to the individual, the loss to society as a whole is determined by averages and may be less. The argument for an arbitrarily low discount on government projects in order to increase society's investment for the future is tenuous at best and should not be accepted. The author indicates that the weighted discount rate outlined lies in the regions of the second best. 'Society could obviously benefit by a transfer of capital from areas in which its social return is relatively low to other parts of the economy offering a higher social return.' However, the paper does not pursue this conclusion into specifics regarding sources of government revenue, and instead points out that there may be externalities not included in differing rates of return. Certain difficulties in actually deriving a social discount from the formula given are pointed out. (See also W70-07288) (Whipple-Rutgers)
W70-07291

THE ROLE OF SOCIAL INDICATORS AND SOCIAL REPORTING IN PUBLIC EXPENDITURE DECISIONS,
Joint Committee on Economics (U.S. Congress). Subcommittee on Economy in Government.
Isabel V. Sawhill.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C. Vol 1, p 473-85, 1969.

Descriptors: *Social aspects, *Economics, *Program evaluation, Benefit cost analysis, Environmental effects, Decision making.
Identifiers: *Social indicators, *Distributional effects, Quality of the environment.

A social indicator is a proxy measure of welfare. Because outputs of so many public expenditures include improvements in some aspect of the quality of life, public decision makers and analysts require some procedures for evaluating or measuring changes in these social characteristics. Recent efforts by the Department of Health, Education and Welfare to develop a set of social indicators are described in this paper, both as to methodology and actualprogress. Aspects of life to be measured include social mobility (correlation between occupational status of father and son), health, physical environment, income and poverty, public order and security, and learning science and art. The author suggests formation of a Council of Social Advisers to establish a link between social indicators and more effective public expenditure. The above considerations apply to effects of water resources programs as well as other programs. (See also W70-07288) (Rutgers-Whipple)
W70-07292

THE ORGANIZATION OF ECONOMIC ACTIVITY: ISSUES PERTINENT TO THE CHOICE OF MARKET VERSUS NONMARKET ALLOCATION,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Kenneth J. Arrow.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 47-64, 1969.

Descriptors: *Economics, *Competition, *Economic efficiency, Third party effects, Cost benefit analysis.
Identifiers: *Externalities, *Price mechanism, Public goods.

While the price mechanism of the private sector is an efficient resource allocating mechanism under many conditions, it fails to function appropriately when certain other conditions prevail. The paper deals mainly with conditions under which the private competitive market system fails to lead to an efficient allocation of resources. Concepts of public goods, externalities, increasing returns, lack of information, and transaction costs are presented as relevant to the market versus nonmarket allocation debate. Such issues are relevant to the economics of water resources. The discussion is relevant to policy questions regarding charging for certain water resources outputs. (See also W70-07288). (Whipple-Rutgers)
W70-07293

PROJECT DESIGN AND EVALUATION WITH MULTIPLE OBJECTIVES,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
A. Myron Freeman, III.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 565-578, 1969.

Descriptors: *Intangible benefits, *Economics, *Economic justification, *Social aspects, *Benefit cost analysis, Benefits, Program evaluation, Economic efficiency.
Identifiers: *Income redistribution, *Multiple objectives, *Non market values, Shadow prices, Public goods.

The problem of choosing between alternative public sector investments is complicated by the fact that the benefits of all programs are not commensurate, since some of them have not been possible to evaluate in money terms. In such cases, the efficiency criterion is not adequate for project evaluation; and even where benefits are evaluable, income redistribution effects remain for consideration. The problem cannot really be avoided, since choices must be made. The first approach which has been proposed to this problem is to evaluate for each alternative the project costs and all tangible benefits, in dollar terms, and then to list the unvalued benefits. This leaves the decision maker to select an alternative based upon his implicit judgment of values. The second approach is to establish some minimum acceptable value for one benefit, and then 'to maximize the other benefit subject to meeting the constraint'. In place of either of the above approaches, the author favors a 'conscious, deliberate selection of weights by decision makers', which in effect would constitute a social welfare function. The author feels that in at least one case, namely income redistribution, it may be possible to infer weightings from legislative enactments of the past. From a practical viewpoint, it seems that useful initiatives of this nature are most likely to come from the Federal executive agencies. Such considerations are applicable to water resources programs. (See also W70-07288). (Whipple-Rutgers)
W70-07294

THE ABSENCE OF KNOWLEDGE OF DISTRIBUTIONAL IMPACTS: AN OBSTACLE TO EFFECTIVE PUBLIC PROGRAM ANALYSIS AND DECISIONS,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
James T. Bonnen.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 419-449, 1969.

Descriptors: *Economics, *Program evaluation, Constraints, Benefit cost analysis.
Identifiers: *Equity, *Distributional effects, Income distribution, Regional income distribution.

Distributional effects constitute an equity issue to which increasing attention is being given, but there is little data for analysis of the issue. Measurement of impacts by region would be desirable, as well as by income, age, sex, family status, degree of urbanization and race of the persons benefitted. Some Federal programs which were created for equity reasons may have perverse distributional consequences. Concerning water resources programs, the author cites recent analyses showing (1) adverse regional distributional consequences of irrigated cotton developments in the west, and (2) favorable distributional consequences of certain Corps of Engineers projects in the south. Much more data is available regarding certain agricultural programs. The author concludes that strong efforts should be made to obtain data and to evaluate distributional consequences of programs. The paper does not define the concepts involved or discuss the relationship between the distributional aspects of benefits and those of taxation. (See also W70-07288). (Whipple-Rutgers)
W70-07296

THE TREATMENT OF RISK AND UNCERTAINTY,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Jack Hirshleifer, and David L. Shapiro.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 505-530, 1969.

Descriptors: *Economics, *Economic efficiency, *Interest, *Discount rate, *Risks, Benefit cost analysis, Program evaluation.
Identifiers: Opportunity costs, Time-state preference, Uncertainty.

There is very little understanding of how the government should adjust to the existence of risk and uncertainty when evaluating alternative public undertakings. Existing Federal practice has been extremely disparate, reflecting the confused state of economic thought on the matter. This paper mainly concerns the discount rate to be used in Federal investment. The authors review the basic propositions on which the economic analysis of public investment rests and discuss meanings attached to 'risk' and 'uncertainty'. One of the key unsolved problems in the literature is that some writers see premiums paid for risk aversion to be a social cost, whereas others argue that such premiums are not socially relevant. In part, the controversy surrounding the appropriate discount rate has resolved about this point. The authors discuss some recent developments of theory, and particularly a model of 'time-state preference', which is viewed as a framework for public sector response to the problems of risk and uncertainty. This model leads to the conclusion that the application of a riskless rate of interest in discounting is inappropriate, and that the 'rule of large numbers' sometimes relied upon to support a disregard for such risks cannot be supported. The authors consider briefly the existence of corporate income tax, which is viewed as an obstacle to optimum investment in risky programs, such that any discount rate chosen for Federal use will lie in the realm of the second best. The questions discussed apply to water resource functions, especially as concerns discount rate used. (See also W70-07288). (Whipple-Rutgers)
W70-07297

UNCERTAINTY AND THE NEED FOR COLLECTIVE ACTION,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Richard Zeckhauser.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 149-166, 1969.

Descriptors: *Risks, Economic efficiency, Economic justification.
Identifiers: *Uncertainty, *Risk aversion, Collective action, Contingent claims markets.

The existence of uncertainty, a lack of knowledge of which state of nature will obtain in the future, may prevent the achievement of optimal results from the free market system. Contingent claims markets, such as insurance systems, are commonly adopted to improve results from the individual's viewpoint. Although transaction costs are not negligible, and the customer may pay more than the actuarial value of the risk prevented, his utility may still be increased if he is a risk averter, as regards his utility function of wealth. Contingent claims markets do not exist in certain fields, and many are unsatisfactory due to deficiency in information. Efficient provision of such goods and services must take into account risk-spreading considerations and utilities in anticipation of use. Institutions available may affect the decision as to whether the goods should be provided and if so by the government unit. The collective provision of goods raises questions of equity if some individuals benefit at the expense of others. The above considerations apply to uncertainty in water resources analysis. (See also W70-07288). (Whipple-Rutgers)
W70-07298

BUDGET 'UNCONTROLLABILITY' AS AN OBSTACLE TO IMPROVING THE ALLOCATION OF GOVERNMENT RESOURCES,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Murray L. Weidenbaum.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 357-368, 1969.

Descriptors: *Economics, *Constraints, *Benefit cost analysis, Decision making, Appropriation, Budgeting.
Identifiers: *Program evaluation, Public expenditure analysis.

Economic analysis can only improve Federal expenditure policy if the analysis can be implemented. Currently a substantial share of the Federal budget cannot be transferred from one program to another by the budget review and appropriation process. Examples are trust funds, permanent and indefinite appropriations fixed charges, and ongoing projects. The author finds that only 52% of the Federal budget is relatively controllable. Under present law it appears futile to perform benefit-cost analysis to demonstrate a higher return obtainable from one program rather than another. It is recommended to reduce the institutional obstacles to the implementation of sound public policy. Water resources presumably would be compared economically to other Federal programs, provided procedures of inter-program analysis suggested in this paper were actually relied upon. (See also W70-07288). (Whipple-Rutgers)
W70-07299

EFFICIENCY GOALS, MARKET FAILURE AND THE SUBSTITUTION OF PUBLIC FOR PRIVATE ACTION,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
John V. Krutilla.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 277-289, 1969.

Descriptors: *Economics, *Resource allocation, *Economic efficiency, *Third party effects, Cost benefit analysis, Decsion making, Interest rates.
Identifiers: *Externalities, Public goods, Price mechanism, Market failure.

This paper considers whether public investments which are undertaken to improve the allocative efficiency of the market necessarily attain that objective. While the failure of the market to reflect social worth of certain outputs and inputs may make public intervention necessary, the result may not be economically efficient. Among the obstacles are cited biases in the application if investment criteria, constraints within the government on replacing traditional policies with more relevant alternatives, and pricing polcies for publicly produced goods. The traditional separation of analysis of economic benefit from questions of reimbursement is conducive to pricing below marginal costs, which in turn may lead to over investment by the government and over consumption in the private sector. A concerted effort should be made to improve government decision-making procedures and pricing policies. These considerations apply to the pricing of water resources outputs. (See also W70-07288). (Whipple-Rutgers)
W70-07300

SHADOW PRICES FOR INCORRECT OR NONEXISTENT MARKET VALUES,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Julius Margolis.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 533-546, 1969.

Descriptors: *Economics, *Economic efficiency, Benefit cost analysis, Market values, Program evaluation.
Identifiers: *Shadow prices, Nonmarket values, Opportunity costs.

In evaluating benefits and costs of various proposals, it is essential to have values assigned in the absence of acceptable market values. This is a frequent case, since government activity is frequently directed towards those activities for which there is no market (including most activities of Federal Water resources). It is the duty of the economist to develop values for outputs and inputs which correspond to those which would have been established by a competitive market if one had existed. Such values are known as shadow prices. The determination of shadow prices is difficult because there is no widespread agreement on the basis for generating social values. The economist should try to aggregate the preferences of people in the society, rather than relying on the preferences of program planners or administrators. The author considers that the willingness of people to pay for government outputs is a measure of social value. However, it is often difficult to estimate willingness to pay; and there are legal and institutional restraints which may lead to errors. The author considers that unless decision makers act on the basis of such prices, little is gained. (See also W70-07288). (Whipple-Rutgers)
W70-07301

EVALUATING PUBLIC EXPENDITURES UNDER CONDITIONS OF UNEMPLOYMENT,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Robert H. Haveman.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 547-561, 1969.

Descriptors: *Economics, *Economic efficiency, *Benefit cost analysis, *Unemployment, Costs, Economic justification.
Identifiers: *Unemployed resources, *Social costs, Non-market values, Opportunity costs.

Public investments may be undertaken under conditions of less than full employment, and, in such a case, resources used which would otherwise be unemployed are valued at a social cost less than the monetary cost, since these resources by definition would not otherwise be producing anything else. Such a divergence between social costs and monetary costs can be observed even under conditions of low over-all unemployment, because of substantial differences of unemployment rates by occupation, by industry, and by region. Using a recently developed computational model, it is explained how the true social cost of a public expenditure can be estimated, by adjusting monetary costs for idle resource use. Through such adjustments, projects with otherwise unacceptable benefit cost ratios may be shown to have social benefits in excess of social costs. Such analyses are presumably applicable to water resources investments as well as other forms of public expenditure. (See also W70-07288). (Whipple-Rutgers)
W70-07302

BENEFICIARY CHARGES AND EFFICIENT PUBLIC DECISIONS,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Jerome W. Milliman.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 291-318, 1969.

Descriptors: *Economics, *Economic efficiency, Resource allocation decision making, Prices, Financing.
Identifiers: *Marginal-cost pricing, *User charges, *Beneficiary charges, Public goods, Price mechanism, Private goods, Equity.

Most observers of public expenditure policy consider that much wider use should be made of user charges (beneficiary charges). However, the literature mingles questions of efficiency, equity and financing, and often treats alike questions involving the scale of new investments and those involving the use of existing facilities. As regards short-run efficiency, or the management and pricing of outputs from a government project, the author sees the

need for further work on both theory and practice. The welledeveloped marginal-cost pricing literature provides one of the determinants for pricing policy, but considerations of cost-recovery and other aspects may also be valid considerations. The imposition of beneficiary charges for public services appear generally desirable, but problems arise in implementation, particularly for services which are of the nature of public goods. The whole question requires much more study. The discussion is relevant to actual and proposed user charges for several water resources outputs. (See also W70-07288). (Whipple-Rutgers)
W70-07304

PERVASIVE ESTERNAL COSTS AND THE RESPONSE OF SOCIETY,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Allen V. Kneese, and Ralph C. d'Arge.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 87-115, 1969.

Descriptors: *Third party effects, *Economics, *Water pollution, *Environmental effects, Resource allocation, Economic efficiency, Wastes.
Identifiers: *Externalities, Waste residuals.

Extensive air and water pollution, urban congestion, landscape deterioration and other environmental aspects of economic growth indicate that externalities and spillovers are pervasive phenomena in our society. These effects are present in most of both production and consumption processes in our economy. The waste residuals to be disposed of in the environment are shown to be approximately equal in tonnage to that of the basic materials utilized by the economy. Such widespread conditions cannot be viewed as anomalies in an otherwise smoothly-functioning market system. The authors argue that most of the formal approaches of economists are of limited usefulness for this reason. In particular, the assumed independence of production and of utility functions in basic economic models becomes less defensible. To analyze such pervasive systems of externalities, the authors outline a more comprehensive economic model, designed to assist decision makers in developing a more effective collective response to pollution-type problems. Environmental controls should be devised such that decentralized voluntary exchanges can again be relied upon to approximate optimal results. (See also W70-07288). (Whipple-Rutgers)
W70-07305

THE PUBLIC SECTOR AND THE PUBLIC INTEREST,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Peter O. Steiner.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 13-46, 1969.

Descriptors: *Social aspects, *Decision making, *Economics, *Economic efficiency, Public benefits, Benefits, Cost benefit analysis.
Identifiers: *Objective function, Public good, Public interest, Social welfare function, Income redistribution.

What should be the appropriate role of the public sector in a society in which most goods and services are provided in a market system based upon individual choices. The economist's definition of public goods is criticized and the reasons for reserving certain activities to the public sector are classified. The concept of public interest is discussed. Difficulties of establishing a single objective function are ennumerated, the author preferring an aggregate social welfare function, based upon revealed social priorities. An argument is given that a single discount rate should not be used, since this implies a lexicographic ordering of objectives. Multiple objective functions cannot well be applied either by assuming one function dominant or by assuming a quantitative relationship between objective functions, which may be erroneous. The author does not favor an efficiency approach, which he regards as implying one of two alternative views: (a) any worthy objective can be included in an efficiency approach by giving it a quantitative value, (b) objectives such as income redistribution should not be included, but should be satisfied by taxes or allocations specifically for that purpose. The above discussion covers points of basic importance to water resources. (See also W70-07288). (Whipple-Rutgers)
W70-07306

SYSTEMATIC ANALYSIS AND GRANTS-IN-AID IN A FEDERAL SYSTEM,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Selma Mushkin, and John Cotton.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printin Office, Washington, D.C., Vol I, p 332-354, 1969.

Descriptors: *Administration, *Management, Operations research, Federal government, State government grants, Economics.
Identifiers: *PPB system, *Grant-in-aid, *Program evaluation, *Public expenditure analysis.

This paper examines the effect of public expenditure analysis upon Federal grant-in-aid programs, especially the shift of emphasis, through the PPB system, from program inputs to program outputs. There appears to be a need for equivalents of the Federal PPB system in state and community governments. The authors consider that the PPB system can aid the Federal government in developing effective incentives and local governments in developing and operating efficient programs. Federal grants now often require program evaluation, systems analysis, and cost effectiveness measurement. Experimental projects should be developed to further develop the methodology and data necessary for program evaluation. The discussion is relevant to the Federal grant-in-aid programs in the water pollution control field. (See also W70-07288). (Whipple-Rutgers)
W70-07307

EVALUATION OF NATURAL RIVERS,
Antioch Coll., Yellow Springs, Ohio.
Morisawa Marie, and Murie Martin.
Available from the Clearinghouse as PB-192 115, $3.00 in paper copy, $0.65 in microfiche. Final Report, (1970). 143 p, 31 tab, 48 fig, 6 plates, 9 ref, 3 append. OWRR Project C-1314 (1966).

Descriptors: *Evaluation, River flow, Water budget, *River basins, *Rivers, *Environment, History, Aesthetics, *Hydrologic data, Surveys, Hydrologic aspects, Data collections, Plants, Aninads, Geologic formations, Geomophology.

The Little Miami in Ohio and the Green in Wyoming were studied to develop methods of gathering quantitative data and using it to evaluate the hydrologic, geologic, biologic aesthetic, and cultural aspects of rivers. Field data on fauna, flora, geology, hydrology, history, and aesthetics were gathered at stations along the river valleys, and classification schemes were proposed.
W70-07327

ECONOMIC VALUES OF IRRIGATION WATER IN FOUR AREAS ALONG THE SNAKE RIVER IN IDAHO.
Idaho Agricultural Experiment Station, Moscow.
For primary bibliographic entry see Field 03F.
W70-07334

CALIFORNIA UNDERSEA AQUEDUCT PRERECONNAISSANCE STUDY.
Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Sacramento, Calif.
For primary bibliographic entry see Field 08A.
W70-07423

BENEFIT-COST ANALYSIS AND THE NATIONAL OCEANOGRAPHIC PROGRAM,
Washington Univ., Seattle. Dept. of Economics.
James A. Crutchfield, Robert W. Kates, and W. R. Derrick Sewell.
Natural Resources Journal, Vol 7, p 361-375, July 1967. 16 ref.

Descriptors: *Cost-benefit analysis, *Economic efficiency, Oceanography.
Identifiers: National Research Council, National Academy of Sciences.

The monograph entitled, Economic Benefits from Oceanographic Research, published by the National Research Council of the National Academy of Sciences (1964), is examined. The basic problems of establishing the appropriate level of oceanographic research and its proper allocation among constituent elements of the program are not resolved by the benefit-cost analysis undertaken in the NAS STUDY. The very process of benefit-cost analysis forces the agencies concerned to isolate and examine the outputs and associated costs resulting from their activities, and may lead to an internal reordering of programs in the direction of greater efficiency. Also, benefit-cost analysis provides a basis for rational choice between programs. A danger of requiring benefit-cost analysis to receive funds from the Bureau of the Budget is that agency planning may be warped in the direction of mission-oriented research as opposed to basic research, and toward applied programs that are less risky. (Grossman-Rutgers)
W70-07529

THE IMPACT OF RESERVOIR RECREATION ON THE WHITNEY POINT MICROREGION OF NEW YORK STATE,
Cornell Univ., Ithaca, N. Y. Dept. of Agricultural Economics.
Robert Charles Hinnan.
A.E. Res. 295, Cornell University Water Resources and Marine Sciences Center, Technical Report No. 18, Aug, 1969. 73 p, 3 fig, 24 tab, 42 ref.

Descriptors: *Recreation, *Economic impact, *Input-output analysis.
Identifiers: *Use survey, *Whitney Point Reservoir Recreation Area.

The setting background and development of the Whitney Point Reservoir Recreation Area are discussed. The study estimates the economic impact of the autonomous investment in developing the area, as well as the impact of the outside users who come to swim, sail, camp, fish, relax and sun. Two methods of analysis and measurement were utilized: (1) a reservoir user survey, and (2) an input-output model or intersection transaction analysis. The user survey method gave an estimate of the gross expenditures by reservoir users. The input-output model showed the underlying structure and interdependencies of the microregional economy. One conclusion of the study is that the introduction of reservoir recreation at Whitney Point has not caused a spectacular economic growth in the microregion. (Grossman-Rutgers)
W70-07545

FLOOD PROOFING: AN ELEMENT IN A FLOOD DAMAGE REDUCTION PROGRAM,
Chicago Univ., Ill.
John R. Sheaffer.
Chicago, University of Chicago, 1960, 198p.

Descriptors: *Floodproofing, *Floods, *Flood damages, *Economic feasibility, Prices, Financing, Cost-benefit analysis, Flood plains, Flood protec-

tion, Salvage value, Economics, Insurance, Watersheds, Costs, Income, Value, Forecasting, Legal aspects, Regional flood.
Identifiers: *Bristol, *Flood adjustments, Flood risk, TVA.

This paper seeks to explore a possible method of mitigating flood damages as well as many of the techniques and economic advantages of private action to avoid flood damage where a flood hazard is already present. The concept of flood proofing is explained, included is an explanation of the elements of a program. A number of model programs are presented and their advantages and disadvantages discussed. The geographic area in study is described along with its flood history, future possible floods and the flood risks. Potential flood losses are estimated using various economic costing methods. Following this, there is a substantial discussion of the economic feasibility of flood proofing in the study area using the method of cost-benefit analysis. A selected sample of establishments in the hazard area was analyzed and the results extrapolated to arrive at an estimate of feasibility for the aggregate. The book concludes with some general observations on flood proofing. (Murphy-Rutgers)
W70-07561

POLLUTION: THE MESS AROUND US,
Wellesley Coll., Mass.
Marshall I. Goldman.
In: Controlling Pollution The Economics of A Cleaner America, Englewood Cliffs, Prentice-Hall, edited by M. I. Goldman, 1967, p 3-39. 40 p, 1 tab, 7 ref.

Descriptors: *Effluents, *Air pollution, *Water pollution, *Population, Pesticides, Fertilizers, Wastes, Sewage, Taxes, Economics, Irrigation, Input/output analysis, Investment, Regulation, Pricing, Rivers, Swimming, Boating, Reservoirs.
Identifiers: *Urban pollution, *Economic inducements, *External diseconomics, Subsidies.

This article discussed the recent surge of interest in pollution. It explains the complexity of the pollution problem and how this problem intensifies with expanding population. The biological view of the interrelation of population and pollution is given. The economic viewpoint is also presented and is at pointed contrast to the biological approach in its knowledge of historical and technological change. A historical development of pollution is given, along with its relation to industry. The problem of pollution control is explained in the economist's terms of external diseconomies. Air and water pollution are discussed, and several solutions are proposed including various forms of direct regulation and such items as subsidization and economic incentives. (Murphy-Rutgers)
W70-07565

THE INFLUENCE OF INFORMATION SIGNS ON VISITOR DISTRIBUTION AND USE,
Utah State Univ., Logan. Inst. for the Study of Outdoor Recreation Tourism.
Perry J. Brown, and John D. Hunt.
Journal of Leisure Research, Vol 1, No 1, p 79-83, Winter 1969. 2 fig, 6 ref.

Descriptors: Sampling.
Identifiers: *Information signs, *Visitor distribution, Advertising, Visitor use, Vehicle stoppage.

Lack of information is a primary factor accounting for visitor jamming recreation sites, overflowing onto highway rights-of-way and blocking facilities. In attempting to attain an even distribution of visitors, the importance of information signing as a management tool is often overlooked. Alfred Oxenfeldt has indicated that advertising (information) alters behavior most efficiently when it supplies information customers are seeking. R. Rocher and F. Kearns noted in visitor characteristic studies that travelers seek different experiences when touring than when at home. Information signs may lead the visitor to these different experiences. Hypothesizing that signs can influence facility use patterns, researchers at Utah State University in 1964 and 1965 conducted a visitor use and motivation study in the Logan Canyon Recreation Complex, Utah. This report focuses on two questions: (1) do information signs help distribute visitors more evenly. (2) Do information signs stimulate greater use of a previously unsigned roadside rest area. The authors conclude that information signs are instrumental in distributing use more evenly between roadside rest-stops and in estimating additional travelers to stop at facilities. They also prepare visitors to stop at facilities. This article may prove valuable to the recreation site manager attempting to increase the number of visits at water-oriented recreation facilities. (Loeb-Rutgers)
W70-07568

UNIFYING ELEMENTS IN THE THEORIES OF THE FIRM,
Patrick Yiung.
Quarterly Review of Economics and Business, Vol 9, No 4, p 21-28, Winter 1969. 8 p.

Descriptors: *Economic analysis, *Profits, *Management, Uncertainty, Linear programming, Model studies, Demand.
Identifiers: *Microeconomics, *Equilibrium, *Therory of firm, Nonmaximization, Joint maximization, Goals.

This article attempts to determine some of the unifying and catalytic elements in the different theories of the firm. The importance of microeconomic analysis in water industry planning makes knowledge of these elements important to the water resource planner. The unifying elements among the different approaches are discussed at different levels of considerations: (1) a general frame of reference, (2) a common drive toward equilibrium, (3) ties between maximizing and non-maximizing approaches, and (4) the coexistence of different goals. The major unifying elements are identified by citing examples from the literature and some suggestions are made with regard to potential development in the field. (Murphy-Rutgers)
W70-07578

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

A MODEL OF RATIONAL COMPETITIVE BIDDING,
Shell Development Co., Modesto, Calif.
For primary bibliographic entry see Field 06A.
W70-07235

A METHOD OF ALLOCATING FUNDS TO INVESTMENT PROJECTS WHEN RETURNS ARE SUBJECT TO UNCERTAINTY,
Smith (A. O.) Corp., Milwaukee, Wis.
For primary bibliographic entry see Field 06A.
W70-07238

THE DEMAND FOR WATER UNDER DYNAMIC CONDITIONS: A CASE STUDY OF BOULDER, COLORADO,
Colorado Univ., Boulder. Dept. of Economics.
For primary bibliographic entry see Field 06D.
W70-07329

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION - VIEWS FROM THE FEDERAL GOVERNMENT: A PANEL DISCUSSION,
Bureau of Reclamation, Denver, Colo. Div. of Project Development.
Jim T. Casey.
Conf. Proc., Comm. on the Econ. of Water Resources Develop., Denver, Colo., p 87-90, Dec 17-18, 1968. 4 p, 1 ref.

Descriptors: *Discount rate, *Evaluation, Economic efficiency, Federal government.

The Water Resources Council discount or interest rate based on a long-term cost of money will yield a higher rate. In the economic analysis process, the interest rate is one component. Present economic analysis needs reassessment in it is ultraconservative and it is directed only towards the goal of economic analysis and almost completely disregards the other objectives of resource development. Examples of these failings of economic analysis are presented. (Grossman-Rutgers)
W70-07546

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (BACKGROUND),
For primary bibliographic entry see Field 06E.
W70-07585

6D. Water Demand

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

THE DEMAND FOR WATER UNDER DYNAMIC CONDITIONS: A CASE STUDY OF BOULDER, COLORADO,
Colorado Univ., Boulder. Dept. of Economics.
Steve H. Hanke.
Available from the Clearinghouse as PB-192 119, $3.00 in paper copy, $0.65 in microfiche. Ph.D. Thesis 1969. 269 p, 22 tab, 26 fig, 5 append, 124 ref. OWRR Project A-005-COLO (11).

Descriptors: *Water demand, *Water rates, Data collections, Statistical methods, Colorado water utilization.
Identifiers: *Boulder (Colorado).

The effects of dynamic shift from a commodity charge of zero to a positive charge via metering of residential water are analyzed. Several models and techniques were utilized to analyze the time series data generated by the introduction of metered rates in Boulder Colorado; graphical analysis, qualitative analysis (interviews), and dynamic quantitative analysis. The conclusion states that the introduction of metered rates did have an effect on residential water consumption. (Grossman-Rutgers)
W70-07329

FORECASTING MUNICIPAL WATER REQUIREMENTS, SYSTEM TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 421, $55.00, Mag tape. Magnetic tape, computer program as documented in Hittman Associates report HIT-413, September 1969, Vol. III, 425 p.

Descriptors: *Water requirements, *Forecasting, *Municipal water, Computer programs, Water demand, Computer models, Statistical models, Regression analysis.

Methods for estimating municipal water requirements and for forecasting the values of municipal water use parameters have been combined to form a comprehensive forecasting method, called the MAIN II System. This tape contains the computer program developed to implement the MAIN II System. Complete documentation is contained in a User's Manual, PB-190 276, titled, 'Forecasting Municipal Water Requirements: Volume II, The MAIN II System User's Manual.' (See W70-04690 in Vol 3, No 12). The computer program is written in ASA Fortran IV language and the magnetic tape contains approximately 3700 records of up to 84 characters each. The tape is recorded in 7 chan-

nels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. The Library of Water Use Coefficients, required by this computer program, is recorded on a separate tape. (Boland-Hittman Assoc)
W70-07580

FORECASTING MUNICIPAL WATER REQUIREMENTS, LIBRARY TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 420, $55.00, Mag tape. Magnetic tape, library data as documented in Hittman Associates report HIT-413, September 1969, Vol II. 425 p.

Descriptors: *Water requirements, *Forecasting, *Municipal water, Computer programs, Water demand, Computer models, Statistical models, Regression analysis.

Methods for estimating municipal water requirements and for forecasting the values of municipal water use parameters have been combined to form a comprehensive forecasting method, called the MAIN II System. This tape contains the Library of Water Use Coefficients used in the implementation of the MAIN II System. The Library is required by the MAIN II System computer program, available on a separate tape. Complete documentation is contained in a User's Manual, PB-190 276, titled 'Forecasting Municipal Water Requirements: Volume II, The MAIN II System User's Manual.' (See W70-04690, Vol 3, No 12). The Library is written in source language format and the magnetic tape contains approximately 1300 records of up to 84 characters each. The tape is recorded in 7 channels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. (Boland-Hittman Assoc)
W70-07581

MAIN C: COMPUTERIZED METHODOLOGY FOR EVALUATION OF MUNICIPAL WATER CONSERVATION RESEARCH PROGRAMS, SYSTEM TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 422, $55.00, Mag tape. Magnetic tape, computer program as documented in Hittman Associates report HIT-409, August 1969, Vol II. 313 p.

Descriptors: *Water conservation, *Municipal water, Computer program, Computer models, Water requirements, Economic impact.

A computer model has been developed which estimates the influence of proposed water conservation devices, processes, or practices on the water requirements of an urban area, including the economic impact on the water supply utility. This tape contains the computer program developed to implement this model. Complete documentation is contained in a User's Manual, PB-190 278, titled 'MAIN C: Computerized Methodology for Evaluation of Municipal Water Conservation Research Programs, Volume II, User's Manual and System Documentation.' (See W70-04691, Vol 3, No 12). The computer program is written in ASA Fortran IV language and the magnetic tape contains approximately 3000 records of up to 84 characters each. The tape is recorded in 7 channels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. The Library of Detail Utilization Factors, required by this computer program, is recorded on a separate tape. (Boland-Hittman Assoc)
W70-07582

MAIN C: COMPUTERIZED METHODOLOGY FOR EVALUATION OF MUNICIPAL WATER CONSERVATION RESEARCH PROGRAMS, LIBRARY TAPE.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-192 423, $55.00, Mag tape. Magnetic tape, library data as documented in Hittman Associates report HIT-409, August 1969, Vol II. 313 p.

Descriptors: *Water conservation, *Municipal water, Computer program, Computer models, Water requirements, Economic impact.

A computer model has been developed which estimates the influence of proposed water conservation devices, processes, or practices on the water requirements of an urban area, including the economic impact on the water supply utility. This tape contains the Library of Detail Utilization Factors required in this analysis. The computer program which utilizes this Library is available on a separate tape. Complete documentation is contained in a User's Manual, PB-190 278, titled, 'MAIN C: Computerized Methodology for Evaluation of Municipal Water Conservation Research Programs, Volume II, User's Manual and System Documentation.' (See W70-04691, Vol 3, No 12). The Library is written in source language format and the magnetic tape contains approximately 1000 records of up to 84 characters each. The tape is recorded in 7 channels, 800 characters per inch, using the Binary Coded Decimal (BCD) limited character set. (Boland-Hittman Assoc)
W70-07583

6E. Water Law and Institutions

ANDERSON-TULLY CO V FRANKLIN (THALWEG OF MISSISSIPPI RIVER AS CONSTITUTING BOUNDARY BETWEEN MISSISSIPPI AND ARKANSAS; ACCRETION AND AVULSION CHANGES OF THALWEG).
307 F Supp 539-547 (ND Miss 1969).

Descriptors: *Mississippi, *Arkansas, *Accretion (Legal aspects), *Avulsion, Legal aspects, Judicial decisions, Erosion, Banks, Bank erosion, Boundaries (Property), Land, Land tenure, Rivers, Mississippi River, Navigable waters, Watercourses (Legal), Riparian waters, Riparian rights, Channels, Thalweg, Beds, Surveys, Maps, Meanders, Riparian land.

Plaintiffs Mississippi riparians instituted suit against defendants Arkansas riparians to quiet title in disputed land located along the Mississippi River, the thalweg of which constitutes the boundary between Mississippi and Arkansas. The dispute was generated by the shifting westward and southward of the thalweg along which the land was located. Ownership of the land depended on whether the land was located in Mississippi or Arkansas. Disposition of the case turned on whether the boundary line between the states ran along the thalweg or along a line of depression said to be the old river run. Plaintiffs alleged the land belonged to them as the result of gradual erosion on the Arkansas side and accretion on the Mississippi side, thus shifting the thalweg. Defendants contended the land was theirs because the shift in the thalweg was due to an avulsion and the boundary between the states remained the old thalweg. The federal district court ruled for plaintiffs on the basis of their clear preponderance of evidence. The boundary line between the states is the thalweg or main channel of the Mississippi River. Case law holds that if a shift in the thalweg is gradual, the boundary follows the shift. If it is sudden, due to an avulsion, the boundary remains the same. Here the shift was gradual and thus by accretion. The land was located in Mississippi and belonged to plaintiffs. (Duss-Florida)
W70-07256

THE RESPONSE OF THE NORTHEASTERN NEW JERSEY WATER TRANSFER NETWORK TO THE 1962-1966 DROUGHT,
Rutgers - The State Univ., New Brunswick, N. J. Dept. of Geography.
Robert M. Hordon.
In: Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), ed. Phillip Cohen, Martha N. Francisco, p 500-510, 7 fig, 13 ref.

Descriptors: *Water transfer, *Droughts, *Flexibility, *New Jersey.
Identifiers: *Graph theory, *Matrix applications, *Water supply agencies, Nodal degrees, Digraph, Linkages, Beta index, Gamma index, Theta index.

The response of a water transfer network to a severe drought is studied using graph theory and matrix applications to analyze nine northeastern counties in New Jersey from 1961 to 1967. During this period, there were 148 water supply agencies in the study area with consumption greater than 100,000 gpd. 91 of these engaged in varying amounts of inter-agency transfers. A network of these agencies called a digraph is presented. Each agency is represented by a node which is connected by directed lines, 'linkages', if there were any transfers during the period. The term 'nodal degree' expresses the number of links extending from a particular node to other nodes. Three indices are presented which express the topological characteristics of a network as it changes over time. The first index Beta denotes the relation between individual elements of a network, the second Gamma is a ratio between the nodes and the links of a network, the third, Theta is a measure of the average volume of water transferred to each node per time period. Expressions for each of these are presented, and suggestions are that the system responded in a relatively limited and rigid manner. Several questions are raised with regard to how other administrative structures might have responded. Matrix applications, their advantages and several applications, are outlined. Conclusions are that 'Balkanization' represents an inadequately connected system incapable of responding rapidly enough to stresses. (Preckwinkle-Chicago)
W70-07286

THE OPTIMAL ALLOCATION OF JURISDICTIONAL RESPONSIBILITY: THE PRINCIPLE OF FISCAL EQUIVALENCE,
Joint Committee on Economics (U. S. Congress). Subcommittee on Economy in Government.
Mancur Olson, Jr.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Joint Economic Committee Print, U.S. Government Printing Office, Washington, D.C., Vol I, p 321-331, 1969.

Descriptors: *Governments, *Administration, *Institutions, Water policy, Local governments, State governments, Economics.
Identifiers: *Public good, User charges, Incentives.

The establishment of institutional arrangements with appropriate functions, sizes and incentives is important to sound public policy implementation. Economic analysis should consider such institutional questions, otherwise built-in incentives may handicap the intentions of the decision-maker. The disparate pattern of jurisdictions amony national, state, county and city governments, with their overlapping network of functions, raises questions as to optimum patterns of jurisdictional responsibility. The paper discusses the optimum match of functions and boundaries, including conditions which may lead to over- or under-production of governmental outputs. Patterns of beneficiary charges and cost sharing are relevant. Ethnic composition and other special non-economic conditions may justify additional governmental units. The author concludes that wide differences in the extent to which impacts of public goods are localized indicate that a broad array of governmental institutions is desirable, since a major discrepancy between the boundaries of a collective good and that of the jurisdiction which provides it is undesirable. The complex governmental network in the U.S. has many faults; but it is probably better than most of the arrangements which have been proposed to replace it. The considerations in the paper appear directly applica-

ble to the framework for administration of water resources. (See also W70-07288). (Whipple-Rutgers)
W70-07295

SWANGO V MCCOUN (INHERITANCE OF EASEMENT IN A SPRING).

301 Ky 219, 191 SW2d 388-390 (1945).

Descriptors: *Kentucky, *Easements, *Springs, *Access routes, Judicial decisions, Legal aspects, Bodies of water, Land tenure, Real property, Spring waters.

Plaintiffs brought suit seeking a judgment declaring them entitled to an easement in a spring. Plaintiffs' ancestor had conveyed to his son a life estate in an acre of land and in use of the spring. The property was to vest in fee simple in the son's heirs at his death. Plaintiffs' ancestor had also sold the land on which the spring was located to defendant's ancestor. Defendant had tried to prevent the son of plaintiffs' ancestor from using the stream but the courts had ruled the son had an easement in the spring and a right of access. After the son's death, defendants barred his heirs, the plaintiffs, from use of the spring. The trial court dismissed their petition, ruling that the right to use the spring was extinguished at the son's death. It based this on the deletion of the words 'and assigns' in the habendum clause of the original deed to the son. The Kentucky court of appeals reversed, ruling that the easement in the spring passed to the heirs regardless of the deletion. (Duss-Florida)
W70-07303

THE LAW OF THE SEA: NATIONAL POLICY RECOMMENDATIONS.
Rhode Island Univ., Kingston. Law of the Sea Inst.

Rhode Island University Technical Report, Proceedings 4th Law of the Sea Institute Conference, June 23-26, 1969, Kingston, Rhode Island; published April 1970. 533 p, 737 ref. Contract Nonr 396 (16), ONR Project No NR 388-083

Descriptors: *Conferences, *International law, *Continental shelf, *Marine fisheries, International waters, Deep-water habitats, Boundaries (Property), Boundary disputes, Offshore platforms, United States, United Nations.
Identifiers: *Sea law, Sea Institute Conference, National policy recommendations, Marine Science Commission.

This volume contains 19 professional papers, critiques of several of these, shorter articles by panel participants, and verbatim discussions covering the four-day conference. The program centered primarily about the international policy recommendations of the Marine Science Commission, and was broken down into the following major subheadings: the deep-seabed and continental shelf; fisheries arrangements; and freedom of scientific inquiry. There were also sessions on offshore boundaries and boundary determination, and on ocean strategy for the United States. Among the contributed papers in the volume are one on the Malta Plan and the United Nations, and another on Mathematical Economics and Marine Resources Research. (Lang-USGS)
W70-07359

THE LOUISIANA STREAM CONTROL COMMISSION'S WATER QUALITY STANDARDS AND PROGRAMS FOR THE LOWER MISSISSIPPI RIVER,
Louisiana Stream Control Commission, Baton Rouge.
For primary bibliographic entry see Field 05G.
W70-07385

INTERNATIONAL CONFERENCE ON OIL POLLUTION OF THE SEA.
For primary bibliographic entry see Field 05C.
W70-07411

UNION FALLS POWER CO V MARINETTE COUNTY (TAX ASSESSMENT OF FLOWAGE EASEMENTS).

238 Wis 134, 298 NW 598-601 (1941).

Descriptors: *Wisconsin, *Easements, *Taxes, *Assessments, Boundaries (Property), Industries, Legal aspects, Judicial decisions, Proprietary power, Relative rights, Riparian rights, Watercourses (Legal), Dams, Flooding, Overflow, Reservoirs, Local governments.

Plaintiff power company owned a dam across the Menominee River. It also owned a flowage easement over those lowlands upriver which were flooded by water impounded by the dam. Defendant county assessed the value of plaintiff's property to include the value of the flowage easement. Plaintiff contended that flowage easements are not real estate and are not assessable for tax purposes, but if they are, they must be assessed against the servient estate over which they flow. A Wisconsin statute defined real property to include rights and privilege appertaining to land. The court held that an appurtenant easement appertains to the dominant estate to which it belongs. As such, it comes within the definition of real property, and its value, for tax purposes, should be included in the assessment of the dominant estate. (Clarke-Florida)
W70-07435

HOLMES V HAINES (ACCRETION; BOUNDARY DISPUTES).
1 NW2d 746-751 (Iowa 1942).

Descriptors: *Iowa, *Boundary disputes, *Accretion (Legal aspects), *Boundaries (Property), Riparian land, Non-navigable waters, Legal aspects, Judicial decisions, Land, Land tenure, Streams, Banks, Beds, Erosion, Soil, Channels, Rivers, Low water mark, High water mark, Bank erosion, Watercourses (Legal).

Plaintiff and defendant were riparian owners along opposite sides of a non-navigable stream. Both had received title to their land through chains which contained no reservations regarding rights in the stream. The stream gradually eroded the defendant's bank and deposited accretions on plaintiff's bank. Defendant sought to establish a channel where the old stream ran. Plaintiff brought suit to quiet title in the accreted land and enjoin defendant from proceeding with the channel. The defendant claimed a fixed and permanent boundary which had never changed but had been destroyed, and that plaintiff had acquiesced in this. The trial court found for plaintiff and the Iowa supreme court affirmed. A conveyance along a stream carries title according to the intentions of the parties. In this case it was clear, as there was no contrary delineation in the titles given by the grantors, that the boundary line was the thread of the stream. The boundary line, being determined by the river, changed when the river changed. Moreover, the land accruing to plaintiff was due to accretion and therefore belonged to plaintiff regardless of whether the boundary line was the river bank or the water channel. (Duss-Florida)
W70-07436

HISTORIC ESTATES, INC V UNITED PAPERBOARD CO (EASEMENT TO SPRING-WATERS).
260 App Div 344, 21 NYS2d 819-823 (Sup Ct 1940).

Descriptors: *New York, *Easements, *Spring waters, *Water contracts, Overlying proprietor, Adjudication procedure, Judicial decisions, Land tenure, Legal aspects, Proprietary power, Relative rights, Water rights, Water transfer, Groundwater, Pumps, Water utilization, Springs, Remedies.

Defendant had a partially written, partially oral agreement with plaintiff's vendor that defendant would have the right to use water from a spring on vendor's land for 21 years. Defendant was to install and maintain a pump and pumphouse capable of supplying water to both plaintiff's and defendant's premises. Defendant fully complied with this agreement. Plaintiff, upon purchasing from vendor, sued to enjoin defendant from further use of the spring-water on the grounds that plaintiff had no actual or constructive notice of the alleged easement. There was no mention of it in any of the deeds applicable to plaintiff's property. The court found that a purchaser may assume that no easements which are not of record are attached to property. However, a purchaser is on notice of those easements that are open and visible and sufficient to indicate the existence of a servitude. In this case the pumphouse was locked, and defendant had the key. Also a power line ran directly from the pumphouse to defendant's premises. These facts were sufficient to put plaintiff on constructive notice that defendant was maintaining the pump to the spring, and the slightest inquiry would have revealed the easement agreement. (Clarke-Florida)
W70-07462

BIERY V CITY OF LIMA (USE OF EMINENT DOMAIN TO ACQUIRE EASEMENT).
255 NE2d 855-858 (Ohio Ct App 1969).

Descriptors: *Ohio, *Eminent domain, *Municipal water, *Cities, Local governments, Consumptive use, Water demand, Water supply, Water conservation, Water requirements, Condemnation, Utilities, Water works, Administration, Land tenure, Legal aspects, Easements, Right-of-way, Compensation, Judicial decisions, Public rights, Condemnation value, Pipelines.

Defendant city sought to establish an easement over plaintiff's property by exercising its power of eminent domain. The city intended to install a pipeline to increase the municipal water supply since local consumption of water was gradually increasing. The city alleged that the situation was an emergency, however, and sought to possess the property without first having compensation assessed by a jury. Plaintiff landowner sought an injunction to restrain the city from taking his property. The court held that the state constitution authorized appropriating property without first assessing compensation only where public exigency required it. The court found that the gradual increase in demand for water did not constitute an emergency or a sudden, pressing and critical need. Although wise policy would dictate a need for increasing the municipal water supply, no situation existed which could be termed a public exigency. The court issued an injunction restraining the city from entering into possession of the easement until a jury decided the amount of compensation due plaintiff. (Hubener-Florida)
W70-07466

ENERGETIC ENFORCEMENT OF INDUSTRIAL WASTE ORDINANCES,
Metropolitan Sanitary District of Greater Chicago, Ill.
Allen S. Lavin.
Proceedings of the Industrial Waste Conference, 23rd, 1968. p 550-553.

Descriptors: *Waste water (Pollution), *Legislation, *Water pollution control, *Industrial wastes, Pollution abatement, Taxes.
Identifiers: Industrial waste ordinances, Anti-pollution laws, Law Enforcement, Tax incentive laws.

The laws and ordinances of agencies charged with the responsibility of protecting our waters against pollution have not been and are not being enforced. There are two controlling factors causing a lack of enforcement. First, it is in the very nature of our economic system that industry will not expend funds that add to the cost of their product until the law demands it. Second, it is the nature of

democratic forms of government that legislatures will not enact new laws, nor will executives enforce them unless the people demand it. Due to public sentiment, government is now being forced into a more active anti-pollution program. The presence of laws, funds, public support, and technology have, however, yet to be coordinated into an effective enforcement program. Most industries, when/and with a summons to show cause why they should not be fined and enjoined for pollution activities, will voluntarily adopt anti-pollution facilities rather than face being the defendant at hearings or in lawsuits and having their public image tarnished. Tax incentive laws will help encourage industry to comply with anti-pollution laws and to provide waste treatment facilities. (Makela-Texas)
W70-07490

SOME LEGAL AND ECONOMIC IMPLICATIONS OF SEA-WATER INTRUSION - A CASE STUDY OF GROUNDWATER MANAGEMENT,
Economic Research Service, Washington, D.C. Farm Production Economics Div.
For primary bibliographic entry see Field 04B.
W70-07524

DANA S COURTNEY CO V QUINNEHTUK CO (EFFECT OF CONTRACTING AWAY WATER RIGHTS).

20 NE2d 399-401 (Mass 1939).

Descriptors: *Massachusetts, *Dams, *Alteration of flow, *Contracts, Judicial decisions, Damages, Damsites, Diversion dams, Diversion structures, Flow control, Water control, Water supply, Powerplants, Flow, Low flow, River flow, Diversion, Duty of water, Obstruction to flow, Relative rights, Diversion losses, Prescriptive rights, Water rights, Legal aspects, Land tenure.

Defendant owned a dam and powerplant on a river above plaintiff's dam and powerplant. Changes in defendant's operation substantially reduced the amounts of water reaching plaintiff's dam, and plaintiff sued for damages and injunctive relief. The court denied relief upon a finding that plaintiff had contracted away his rights to an undiminished flow of water. In earlier deeds executed by the respective predecessors in title defendant was given unlimited rights to the water in the stream, and the court found that plaintiff's water rights were subordinate to the rights of defendant to divert as much water as he saw fit for any purpose. The deeds clearly negatived any implied easement of a sufficiency of water in plaintiff's favor. The court further found that plaintiff had not acquired water rights by precription because no water had been taken adversely to defendant. The water received by plaintiff was under his right as a lower proprietor to receive such water as defendant did not choose to divert. (Douberley-Florida)
W70-07525

R DUNKEL, INC V BARLETTA CO (LIABILITY FOR DAMAGE CAUSED WHILE CONSTRUCTING CULVERTS).
18 NE2d 377-379 (Mass 1938).

Descriptors: *Massachusetts, *Conduits, *Overflow, *Construction, Judicial decisions, Damages, Flood damage, Culverts, Conveyance structures, Rain, Rain water, Runoff, Obstruction to flow, Barriers, Streamflow, Concrete placing, Casings, Excessive precipitation, Streams, Floods, Legal aspects.
Identifiers: *Freshets, Negligence.

A small brook flowed through a culvert under the floor of the basement of a building occupied by plaintiffs. During a rainstorm the culvert overflowed and plaintiffs' property was damaged. Defendant was sued for damages on grounds that the overflow was caused by obstructions placed in the culvert below the premises by defendant. Defendant had placed concrete forms in the culvert pursuant to a contract with the city to construct a conduit for the brook. The court found that the obstruction caused by the forms themselves was not negligence because it was a necessary incident to the proper performance of the contract. There was no negligence unless the erection of the obstruction was performed in a careless and negligent manner, and the jury did not so find. The court also found no evidence upon which the jury could have found the increased flow sufficient to constitute such a freshet as to make the narrowing of the passage actionable. (Douberley-Florida)
W70-07526

MILLSPAUGH V NORTHERN INDIANA PUBLIC SERVICE CO (TORT LIABILITY FOR DEATH OF FISHERMAN IN NON-NAVIGABLE, PRIVATE STREAM).

12 NE2d 396-402 (Ind Ct App 1938).

Descriptors: *Indiana, *Drowning, *Permits, *Fishing, Judicial decisions, Public rights, Underwater, Hazards, Safety, Damages, Dams, Dam construction, Damsites, Overflow, Sport fishing, Non-navigable waters, Ownership of beds, Streambeds, Precriptive rights, Powerplants, Easements, Relative rights, Legal aspects.
Identifiers: Fishing rights.

Plaintiff sued defendant power company for the wrongful death of plaintiff's husband, who drowned while fishing in a stream, the level of which was raised by defendant's dam. When the dam was constructed defendant had failed to completely destroy a submerged older dam, and the boat of the deceased capsized because of currents created around the remaining portions of the dam. The court found that the decedent did not have a right to use the waters for fishing. At the point where the boat capsized the stream was non-navigable and therefore subject to private ownership. Since defendant owned the banks of the stream, and therefore the stream bed, the court held that it also held exclusive rights for fishing. No public easement existed for fishing on private waters, and the decedent had not acquired fishing rights by prescription. Even if the decedent had been viewed as a licensee, the court found that he would have been a licensee by permission and not by invitation. As such, he took the premises as he found them, and defendant was not held to be liable to the licensee for any injuries owing to defects in the condition of the premises. (Douberley-Florida)
W70-07532

MIDDLE ISLAND LAND AND WATER CO V HUTNER (EFFECT OF IMPROPER TAX DEED ON OWNERSHIP OF BEDS).

259 App Div 294, 19 NYS2d 176-181 (Sup Ct 1960).

Descriptors: *New York, *Boundary disputes, *Ownership of beds, *Taxes, Adjudication procedure, Boundaries (Property), Judicial decisions, Land tenure, Legal aspects, Local government, Proprietary power, Riparian land, Riparian rights, Non-navigable waters, Lakes, Lake beds, Assessments, Relative rights.
Identifiers: *Liens.

Plaintiff owned a large tract of land on which was located a non-navigable lake. Plaintiff conveyed a 2 1/2 acre plot under the lake by purchase money mortgage. Two years later the county foreclosed against the mortgagor for failure to pay the property taxes, and issued to defendant a tax deed which described the property to include the 2 1/2 acre underwater plot. Plaintiff contended that his mortgage lien was superior to the tax lien upon which the tax deed rested. The court found that the county had assessed the entire bed of the lake against the plaintiff during the delinquent years, and that the plaintiff had paid the taxes so assessed, including those on the 2 1/2 acre plot. Thus, the tax lien was based in part upon a plot of land on which there were no unpaid taxes. A tax lien is either valid or invalid in its entirety; therefore the tax deed to defendant was void. Plaintiff retained his mortgage and defendant received a judgment against the county for amounts paid thereto. (Clarke-Florida)
W70-07540

ADMINISTRATION OF WATER RESOURCES IN NEW MEXICO,
New Mexico State Univ., University Park. Water Resources Research Inst.
Ira G. Clark.
Available from the Clearinghouse as PB-192 311, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute, WRRI Research Report No. 3, June 1968. 30 p, 2 charts. OWRR Project A-012-NMEX (2).

Descriptors: *Administrative agencies, Domestic water, Public acequias, Drainage districts, Interagency cooperation, *Local governments, Public health, Reclamation, Recreation, Small watersheds, Soil conservation, *State jurisdiction, Water districts, Water permits, Well regulation, *New Mexico, Interstate commissions, Irrigation districts, Water law.
Identifiers: Conservancy districts.

This manual contains a brief summary of New Mexico water law, following by a concise description of every agency -- state, local, or federal -- which has any substantial connection with the administration of the water resources of the state. The basic information relating to the state and local agencies is reduced to two charts. The result is a compact, ready-reference handbook which, for the first time, supplies a comprehensive overview of all such agencies operating in the state, and basic information on each; organization and administration; activities (supervisory, planning and design, construction, operation and maintenance); economic and conservation functions; special powers (fiscal, regulatory, eminent domain, etc.). Sources for the handbook were the New Mexico Revised Statutes, Code of Laws of the United States, United States Government Organization Manual for 1967-68, and reports and releases of the agencies themselves.
W70-07543

RILEY V JONES (PRESCRIPTIVE RIGHT TO USE SPRING WATERS).

295 Ky 389, 174 SW2d 530-532 (Ct App 1943).

Descriptors: *Kentucky, *Prescriptive rights, *Easements, *Spring waters, Water rights, Legal aspects, Judicial decisions, Springs, Land, Land tenure, Wells, Pipes, Water utilization, Pipelines, Right-of-way, Relative rights, Real property.
Identifiers: *Adverse possession.

Plaintiff brought suit to enjoin defendant from interfering with plaintiff's right to receive water on his land from a spring located on defendant's land. Originally, the lands of plaintiff and defendant had been under common ownership. The original owner had created a dominant-servient estate relationship by selling the land containing the spring but reserving the right to use the water by way of a pipe to his remaining land. Later, both tracts of land eventually came under common ownership again, without any reservation for use of the spring water. Plaintiff and defendant then come to own the respective tracts and in defendant's deed to the land containing the spring there was recital of the original reservation concerning use of the water. Plaintiff contended that the right of the dominant estate was revived even though the two estates had been reunited without any reservation, and that the plaintiff had acquired the right by adverse possession. The Kentucky court of appeals affirmed the trial court's granting of an injunction on the basis of adverse possession. It found that the merger of the original estates had extinguished the pre-existing easement. Such easements are revived in case of

severance only if they are 'ways of necessity.' However, the recitals of the reservation in defendant's deed put defendant on notice of the water pipe and plaintiff's actual use ripened into a prescriptive right after fifteen years. (Duss-Florida)
W70-07558

PUBLIC OWNERSHIP CONSTRAINTS ON UTILITY MANAGEMENT,
Oregon Univ., Eugene.
Roy J. Sampson.
Journal of the American Water Works Association, Vol 61, No 10, p 495-499, October 1969, 5 p.

Descriptors: *Management, *Public utilities, *Planning, *Pricing, Economic evaluation, Profits, Regulation, Competition, Forecasting, Economic efficiency, Prices, Taxes, Costs, Financing, Water rates.
Identifiers: *Social values, *Private utilities, Rate of growth.

The article discusses a number of management issues arising out of the existence of publicly regulated or publicly owned water utilities. The author feels that the overriding problem for these utilities is to achieve a balance between public and private ownership, regulation and nonregulation, and managerial flexibility and managerial constraints that will allow them to regain and retain as much of the innovative spirit of management as possible. This should be in conjunction with giving the public the most economically efficient service and protecting it against the possible abuses. This would require that publicly-owned businesses be operated as nearly as possible like privately-owned businesses and that regulated businesses be subjected only to the minimum socially necessary regulation. The author gives attention to the management functions and explains the pricing concepts that should be followed. (Murphy-Rutgers)
W70-07560

SCOTTISH RIVER PURIFICATION BOARDS,
Organization for Economic Co-Operation and Development, Paris (France).
Fred H. Hubbard.
Natural Resources Journal, Vol 9, No 4, p 489-517, October 1969. 1 fig, 4 tab.

Descriptors: *Water pollution, *Water pollution control, Water management, Wastes, Construction, Waste treatment.
Identifiers: *River purification boards, Scotland, Arrangements, Discharge license, Consent condition, Enforcement, Fish life, Regionalization.

Arrangements for administering programs are fundamental to success in solving the problem of water pollution. Arrangements are, however, difficult to develop, particularly in modern urban settings involving large geographical spaces, complex hydrologic conditions, large populations with different social and economic interests, and varied legal and political responsibilities. A large body of literature has been published in recent years calling attention to the significant role arrangements play in water management. When an arrangement is developed that appears to achieve this difficult task, it is a matter of interest for possible application elsewhere such as in pollution control in outdoor recreation water facilities. This article is based on information obtained from Scottish pollution control officials and other informative sources during September 1967 to May 1968. This article focuses attention on the river purification program. It discusses organization and operation of river purification boards and the results achieved. It also assesses the boards' contribution to controlling pollution. (Loeb-Rutgers)
W70-07566

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (BACKGROUND),
Jeffery O'Connell.
Iowa Law Review, Vol 47, No 3, p 549-557, Spring 1962. 8 p, 58 ref.

Descriptors: *Iowa, *Water permits, *Water shortage, *Water rights, Legislation, Humid areas, Permits, Administrative agencies, Regulation, Surface waters, Groundwater, Water resources development, Flood control, Planning, Census, Surveys, Consumptive use, Irrigation, Domestic water, Industrial use (Water), Droughts, Water users, Riparian rights, Water utilization, Optimization, Legal aspects.

With strains on the availability of water, the humid Eastern states, including Iowa, are turning to the Western approach of regulating water by the issuance of permits from the government. In 1957, Iowa established a permit system administered by a Water Commissioner and regulating both surface and groundwater. An earlier statute had set up a Natural Resources Council to institute a state-wide program for flood control and water resources conservation and development. It was also to establish and enforce a comprehensive plan for water control. The Council's inventory of available water indicated a possible water crisis. Irrigation was found to be the most consumptive use because vast quantities are required and it is not returned to the source. Per capita consumption also has increased dramatically because of more uses in the home and greater consumption by industry. Severe draughts in the mid-1950's caused concern among water users of all types, and it became obvious that the wasteful riparian rights system was inadequate to cope with the crisis. The Council recommended changes in the Iowa water law, and the 1957 Water Rights Law resulted. (See also W69-00338) (Douberley-Florida)
W70-07585

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (TERMS OF THE STATUTE AND THE HYDROLOGIC CYCLE),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 557-565, Spring 1962. 8 p, 48 ref.

Descriptors: *Iowa, *Water rights, *Legislation, *Hydrologic cycle, Beneficial use, Domestic water, Industrial water, Municipal water, Water permits, Permits, Administrative agencies, Administration, Regulation, Natural streams, Diversion, Withdrawal, Storage, Groundwater, Drainage water, Settling basins, Surface runoff, Impoundments, Impounded waters, Hydrologic aspects, Water sources.

Iowa's new water statute requires that the state's water resources be put to beneficial use to the fullest extent. Waters in any natural waterbody are public waters and subject to state control and development. The act establishes a permit system administered by a Water Commissioner. It requires permits for the diversion, storage or withdrawal of water from any watercourse, underground source, drainage ditch or settling basin. Exempt or non-regulated uses include domestic uses and existing beneficial uses within municipal corporations. Persons also retain the right to use and drain diffused surface waters and to impound water on their own property. Most water users in municipalities are not required to procure permits. The procedure for obtaining a permit requires notice and a hearing, with provisions for appeal. The Commissioner determines whether the use will be in the public interest and whether the average minimum flow is preserved. Permits are granted for a maximum of ten years. The permit does not constitute an absolute right to use, for the waters are subject to the principle of beneficial use. Provisions are made for extending, cancelling, modifying or suspending permits. The hydrologic cycle is outlined in brief. (See also W69-00338) (Douberley-Florida)
W70-07586

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (PRE STATUTORY SURFACE WATER RIGHTS),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 565-568, Spring 1962. 4 p, 18 ref.

Descriptors: *Riparian rights, *Natural flow doctrine, *Reasonable use, *Iowa, Water rights, Surface waters, Riparian land, Artificial use, Alteration of flow, Domestic water, Irrigation water, Industrial water, Natural use, Prior appropriation, Relative rights, Usufructuary right, Riparian water loss, Riparian waters, Beneficial use, Preferences (Water rights), Administration, Humid areas, Legal aspects, Water utilization.

Prior to the enactment of Iowa's new water rights law, Iowa, like most humid Eastern states, followed the doctrine of riparian rights in governing the use of surface water in watercourses. The doctrine is one of two general systems used in the United States and is itself comprised of two different theories. Under the natural flow theory, each riparian owner is entitled to have the watercourse maintained in its natural state, although each has the right to use water for his natural and artificial uses on riparian land. Under the reasonable use theory, each riparian owner can make a beneficial use of water so long as he does not unreasonably interfere with the same right of any other riparian. Under the natural flow theory, a cause of action accrues even if there is no harm to anyone, and water use is restricted to riparian land. Under the reasonable use theory, there must be an unreasonable interference with another's rights, and water may be used on non-riparian land. Most courts combine the two theories when dealing with riparian rights. Domestic uses are usually considered to be reasonable, and any non-riparian use is unreasonable per se. (See also W69-00338) (Douberley-Florida)
W70-07587

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (ADVANTAGES OF THE STATUTE OVER COURT ADMINISTERED RIPARIAN RIGHTS LAW),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 568-577, Spring 1962. 9 p, 46 ref.

Descriptors: *Groundwater, *Surface-groundwater relationships, *Administrative agencies, *Iowa, Riparian rights, Hydrogeology, Subsurface waters, Percolating water, Underflow, Bodies of water, Groundwater basins, Groundwater movement, Hydrologic cycle, Overlying proprietor, Underground streams, Beneficial use, Judicial decisions, Administration, Surface waters, Planning, Legal aspects, Permits, Appropriation, Legislation.

Owners above underground streams have riparian rights similar to surface rights. It is presumed that underground water is percolating water, however, and it is often treated as a paat of the real estate. Before the statute, Iowa held that the owner of the land could, without wasting it, use the groundwater for any beneficial purpose. To allow unrestricted use of groundwater but only reasonable use of surface water ignores the hydrologic cycle. Legal doctrine often ignores geologic fact because the artificial classifications of the phases are literally observed. There is no real distinction between percolating waters and underground streams. The courts lack expertise and have not been able to implement comprehensive plans. Courts cannot take preventive action and cannot reach those not party to suits. Court procedures are also very costly. Administrative agencies on the other hand have the needed expertise. They are not limited to considering the instant dispute, but must consider the public's interests. The individual decisions arising out of permit application fit into a comprehensive plan. The Iowa agency administers a combination of riparian-appropriation system, although the con-

cept of riparian rights is changed very little by the new Iowa statute. (See also W69-00338). (Douberley-Florida)
W70-07588

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (WASTE UNDER THE RIPARIAN DOCTRINE AND THE NEW STATUTE),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 577-581, Spring 1962. 4 p, 18 ref.

Descriptors: *Iowa, *Optimum development plans, *Water utilization, *Permits, Legislation, Water resources development, Planning, Water conservation, Riparian rights, Riparian owners, Riparian land, Riparian waters, Water rights, Reasonable use, Preferences (Water rights), Competing uses, Water allocation (Policy), Legal aspects.

Waste of water resources is inherent in the riparian rights system. Only small riparian tracts abutting the watercourse may benefit from the water, and rights are so vague that users are often afraid to make full use of the water. The Iowa act does not limit water to riparian uses. The permit gives the permittee some assurance of water, at least for the term of the permit. The cost of granting certain, perpetual rights would be an inflexible system and continued waste of water resources. The maximum permit is therefore ten years, although they are usually limited to seven years. The short term poses some problems for capital investments, but the Water Commissioner has seen no adverse effects. Water rights are still uncertain over a long period of time, and this results in some waste, but it is an improvement over the uncertainty of the reasonable use theory. Some certainty is sacrificed for flexibility. (See also W69-00338) (Douberley-Florida)
W70-07589

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (RIPARIAN RIGHTS AS VESTED RIGHTS),
Jeffery O'Connell.
Iowa Law Review, Vol 47, No 3, p 581-594, Spring 1962. 13 p, 90 ref.

Descriptors: *Water rights, *Compensation, *Riparian rights, *Iowa, Water allocation (Policy), Legislation, Preferences (Water rights), Water contracts, Water permits, Navigable waters, Ownership of beds, Streambeds, Judicial decisions, Iced lakes, Natural use, Domestic water, Regulation, Regulated flow, Artificial uses, Water utilization, Stock water, Reasonable use, Municipal water, Groundwater, Legal aspects.

In determining whether due process requires that compensation be paid for taking vested water rights, the essential question is whether the statute unreasonably alters expectations normally flowing from the property interest. The general view is that there are no private property rights in navigable streams, and it has been argued that Iowa's water rights statute does not affect riparian rights in streams with privately owned beds. Because natural or domestic uses are the equivalent of nonregulated uses, the right to water for domestic uses is preserved by the established average-minimum-flow concept. Also, rights to water for artificial uses are vested and preferred to any nonriparian's rights. However, it is not clear from the statute that riparian rights are preserved. The statute abolishes unused existing rights, and existing uses may have been changed by allowing unlimited use for livestock as a domestic use. The statute also treats municipal uses as equivalent to domestic uses, which may affect uses by riparians. The statute substantially changes rights to groundwater, which indicates that riparian rights were not preserved intact. (See also W69-00338) (Douberley-Florida)
W70-07590

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (THE COURTS' VIEWS OF WATER LEGISLATION),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 594-606, Spring 1962. 12 p, 75 ref.

Descriptors: *Riparian rights, *Water allocation (Policy), *Relative rights, *Public rights, Oregon, Judicial decisions, Legislation, Compensation, Regulation, State governments, Beneficial use, Water conservation, Administration, Water rights, Competing uses, Remedies, Administrative decisions, Water policy, Iowa, Legal aspects.
Identifiers: Vested rights.

To say that riparian rights are vested rights is not to say that they cannot be subject to state regulation without compensation. State ownership of water is not ownership in a proprietary sense. Because of the nature of water, riparian rights are susceptible to change by regulation, and a change in water rights by reasonable regulation does not deprive a riparian of property without due process of law. The Supreme Court favors state legislation regulating economic interests, and because of its importance the Court has been particularly deferential toward state action concerning water. Recognizing the states' interest in water, the Court would be expected to readily defer to a state's decision to change its system of water law to insure the beneficial use and conservation of water. The Oregon courts have upheld statutes that subjected water rights to reasonable regulation in the public welfare, even where vested riparian rights were substantially modified. (See also W69-00338) (Douberley-Florida)
W70-07591

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (DISTINCTION BETWEEN EXISTING AND UNUSED RIGHTS TO WATER),
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 606-615, Spring 1962. 9 p, 63 ref.

Descriptors: *Riparian rights, *Equitable apportionment, *Iowa, *Usufructuary right, Water distribution (Applied), Legislation, Water rights, Preferences (Water rights), Regulation, Relative rights, Water allocation (Policy), Water contracts, Water utilization, Water users, Optimization, Public rights, Navigable waters, Governments, Legal aspects.

The Iowa water statute would probably be held constitutional if construed as regulating only unused rights while preserving existing uses, but it is questionable whether the distinction is so basic as to justify a constitutional differentiation. The property interest in a riparian right is only usufructuary; it is a right to have the water flow to the owner for capture. The only distinction between existing and unused rights is how soon the right will be exercised. Even the bare right to use water is limited by the supply, governmental controls, and the reciprocal rights of others, which are preserved by rules of equitable distribution. The more the right is made uncertain by these factors, the less likely a change by legislation will be unconstitutional. The right to gain available water is in the nature of a property interest, but there is no property interest in the rules for equitable distribution prevailing at any time. A change in the rules that destroys equitable distribution will be unconstitutional, but a change that reflects changing needs will be more likely to be upheld. The system may constitutionally change if it is in the public interest and does not disturb the reasonable expectations of those with a right to use the water. (See also W69-00338) (Douberley-Florida)
W70-07592

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING USES OF WATER (CHANGES MADE BY THE STATUTE).
Jeffrey O'Connell.
Iowa Law Reviews, Vol 47, No 3, p 615-626, Spring 1962. 19 p, 104 ref.

Descriptors: *Iowa, *Riparian rights, *Water rights, *Legislation, Relative rights, Administrative agencies, Adjudication procedure, Water permits, Domestic water, Stock water, Municipal water, Industrial water, Industrial water, Artificial use, Regulation, Reasonable use, Competing uses, Equitable apportionment, Prescriptive rights, Water distribution (Applied), Water allocation (Policy), Legal aspects, State governments.

The Iowa water statute provides for the determination of proper use by a Water Commissioner, not after a dispute arises, but before the issuance of a permit. Except for the rights of nonriparians, the statute makes few changes because of the similarity between statutory nonregulated uses and common law domestic uses. The statute exempts uses for livestock, but this does not work a material change in existing law. Certain municipalities and industrial users are changed from the artificial uses classification to a domestic uses classification, but there is existing authority that municipal uses take precedence over other riparian rights as being in the public interest and as domestic uses. The statute applies the reasonable use standard to artificial uses, changes the rule by emphasizing priority of use when the permit is issued, allows a permit even where another is issued, and allows apportionment among competing users. The provision for loss of water rights for nonuse is only a shortening of the time for loss by prescription under the common law, and in practice this change will not be a drastic one. (See also W70-07584) (Douberley-Florida)
W70-07593

IOWA'S NEW WATER STATUTE--THE CONSTITUTIONALITY OF REGULATING EXISTING USES OF WATER (CONCLUSION).
Jeffrey O'Connell.
Iowa Law Review, Vol 47, No 3, p 634-636, Spring 1962, 3 p, 7 ref.

Descriptors: *Iowa, *Compensation, *Equitable distribution, *Adjudication procedure, Legislation, Water rights, Hydrologic aspects, Hydrology, Reasonable use, Administration, Administrative agencies, Water permits, Regulation, Federal government, State governments, Riparian rights, Relative rights, Legal aspects.

The Iowa water statute makes changes in common law rights to water, but it is not thereby unconstitutional. The test of constitutionality should be whether the legislation is rationally designed to solve the problems it purports to solve and whether the change in property rights is so drastic and unexpected that fairness calls for compensation. The common law doctrines are hydrologically unsound and common law rights are so uncertain that they may be subjected to substantial change without being unconstitutionally impaired. The Iowa statute preserves an equitable system of distribution similar to the doctrine of reasonable use. The determination of reasonable use is constitutional under both the federal and Iowa constitutions. The statute may not be the best possible approach, but it is within the zone of reasonableness and therefore is constitutional. (See also W70-07584) (Douberley-Florida)
W70-07594

FLUCTUATING SHORELINES AND TIDAL BOUNDARIES: AN UNRESOLVED PROBLEM.
Peter K. Nunez.
San Diego Law Review, Vol 6, No 3, p 447-469, July 1969. 23 p, 94 ref.

Descriptors: *California, *Shores, *High water mark, *Boundary disputes, Tides, Boundaries (Property), Judicial decisions, Legal aspects, Accretion

(Legal aspects), Avulsion, Bank erosion, Water law, Water rights, Littoral, Oceans, Ocean waves, Sea level, Tidal effects, Water levels, Beaches, Littoral drift, Intertidal areas, Beach erosion, Riparian rights, Reservation doctrine, Submerged Lands Act, Relative rights, Ownership of beds.

The California case of People v William Kent Estate Co is analyzed in view of various principles and laws affecting tideland ownership. The issues of the case involve beach front property and a fluctuating shoreline. The determination of tidal boundaries and the types, uses and computation of tidal datum are discussed. As a general American rule, the common law principles of tidal ownership are accepted-- title to all lands below the ordinary high water mark belongs to the sovereign. However, a significant number of coastal states have adopted the use of other tidal datum to determine tideland ownership. An examination of the various attempts to define ordinary tides is presented. The English, federal, and California definitions of ordinary tides are examined. The boundary problem in this case involved more than a misapplication of the California rule concerning the computation of ordinary or mean high tides. The fluctuating shoreline created the issue as to the characterization of the fluctuations as natural erosion and accretion or alluvion and avulsion. Another issue involved how long a period of time must pass for a change to be gradual and imperceptible in order to be classed as an accretion rather than an avulsion. The court's determination of these issues is reviewed. The court's novel proposal for determining the location of the tidal boundary is discussed. Two alternative methods of determining such boundaries are also presented. (See also W70-07596 thru W70-07597) (Powell-Florida)
W70-07595

FLUCTUATING SHORELINES AND TIDAL BOUNDARIES: AN UNRESOLVED PROBLEM (LOCATION OF TIDAL BOUNDARIES).
Peter K. Nunez.
San Diego Law Review, Vol 6, No 3, p 447-461, July 1969. 15 p, 73 ref.

Descriptors: *California, *Shores, *Boundary disputes, *High water mark, Tides, Boundaries (Property), Judicial decisions, Legal aspects, Accretion (Legal aspects), Avulsion, Bank erosion, Littoral, Oceans, Ocean waves, Sea level, Tidal effects, Water levels, Beaches, Littoral drift, Intertidal areas, Beach erosion, Riparian rights, Relative rights, Low water mark, Surveys, Measurement.

The location of a tidal boundary is dependent upon the fluctuations of the tides. From observations of the tides, tidal datum planes are computed. Tidal boundaries involve two engineering aspects: a vertical one, predicated on the height reached by the tide during its vertical rise and fall, and constituting a tidal plane or datum; and a horizontal one, related to the line where the tidal plane intersects the shore to form the tidal boundary desired. Characteristics of tides are influenced by four factors: (1) tide-producing forces of the sun and moon; (2) bottom topography and configuration of the major ocean basins; (3) bottom topography and configuration of bays and estuaries; and (4) meteorological phenoma. To obtain a reliable mean value for tidal datums, because of astronomic factors which have a 18.6 year cycle, tides are observed for almost 19 years. Daily, semidaily and mixed are the three types of tides. Of the four tidal datums, mean low water, mean high water, mean lower low water and mean higher high water, the former two have received almost universal acceptance because they are incidental of all three types of tides. The United States Coast and Geodetic Survey determines these values. *See also W70-07595) (Powell-Florida)
W70-07596

FLUCTUATING SHORELINES AND TIDAL BOUNDARIES: AN UNRESOLVED PROBLEM (ACCRETION AND AVULSION).
Peter K. Nunez.
San Diego Law Review, Vol 6, No 3, p 462-469, July 1969. 8 p, 19 ref.

Descriptors: *California, *Shores, *Accretion (Legal aspects), *Avulsion, Boundary disputes, High water mark, Tides, Boundaries (Property), Judicial decisions, Legal aspects, Bank erosion, Littoral, Ocean waves, Sea level, Tidal effects, Water levels, Beaches, Littoral drift, Intertidal areas, Beach erosion, Riparian rights, Relative rights, Surveys, Measurement, Low water mark.

Accretion is the gradual and imperceptible accumulation of land by natural causes. Avulsion is the loss of lands bordering on the seashore by sudden or violent action of the elements, perceptible while in progress. The distinction between the two involves an issue of time--how long a period of time must pass for a change to be gradual and imperceptible. The common-law test is that though the witnesses may see from time to time that progress has been made, they cannot perceive it while the process was going on. The court in People v William Kent Estate Co, 242 Cal App 2d 156, 51 Cal Rptr 215 (1966), in determining the location of the boundary, directed the parties to attempt to determine the average line of the shore against which the ordinary high-water datum could be applied. This would create a fictional but stable shoreline. There are two other proposals for determining tidal boundaries. The first possibility is to adopt as the boundary the ordinary high-water mark as it exists when erosion has had its maximum effect, when that mark is at its extreme landward migration. The other solution is the opposite extreme: adopt as the boundary the ordinary high-water mark as it exists when accretion is at its maximum. (See also W70-07595) (Powell-Florida)
W70-07597

SCHMIDT V MARSCHEL (TITLE TO ACCRETED LANDS; ADVERSE POSSESSION).
2 NW2d 121-124 (Minn 1942).

Descriptors: *Minnesota, *Accretion (Legal aspects), *Riparian rights, *Boundary disputes, Land tenure, Legal aspects, Judicial decisions, Navigable water, Land, Non-navigable waters, Lakes, Riparian land, Shores, High water mark, Meanders, Bodies of water, Watercourses (Legal), Relative rights, Boundaries (Property).
Identifiers: *Adverse possession.

Plaintiffs brought suit to partition a tract of relicted land situated between a lake shore and plaintiffs' property. Defendant, property owner adjacent to plaintiffs, had occupied the land and treated it as his own for a 44 year period before the suit. The trial court concluded that the defendant was owner in fee simple, having acquired title by adverse possession, and the Minnesota supreme court affirmed. Riparian owners take title to land on navigable lakes to the high water mark and have rights to accretions and relictions. However, a riparian owner of such land may be divested thereof by adverse possession. The evidence clearly established that defendant acquired title by adverse possession, having used the property in various agricultural pursuits including renting the disputed land to plaintiffs for pasture. The fact that defendant did not intend to take land not belonging to him does not remove the element of hostility required in adverse possession. His possession was actual, open, notorious, and hostile, and title ripened despite his state of mind as to the actual ownership. (Duss-Florida)
W70-07598

MCCOY V RANKIN (NATURAL FLOW EASEMENT ACROSS LOWER ESTATE)

42 NE2d 234-240 (Ohio Ct App 1941)

Descriptors: *Ohio, *Natural flow, *Repulsion (Legal aspects), *Riddance (Legal aspects), Surface drainage, Surface runoff, Obstruction to flow, Legal aspects, Judicial decisions, Land, Land use, Land tenure, Easements, Embankments, Overflow, Dams, Ditches, Drains, Tile drains, Damages, Channels, Watercourses (Legal), Discharge (Water), Civil law.
Identifiers: *Servitudes.

Plaintiff upper landowner brought suit to enjoin defendant lower landowner from maintaining a dam across a drainage ditch. It was contended that the dam obstructed the natural flow of surface water and backed it up onto plaintiff's land. Prior to the construction of defendant's dam, the plaintiff had constructed on his premises a tile drain which discharged into the ditch. At the trial defendant alleged plaintiff's actions had increased the flow of the ditch beyond capacity, thus damaging defendant's land and justifying the dam. The trial court found for the plaintiff and the Ohio court of appeals affirmed holding that the lower landowner owes a servitude to the upper owner to receive the water that naturally flows from it. The upper owner has, although he cannot artificially change it to the damage of the lower owner, a natural easement in the lower property to the extent of the natural flow. The upper owner may in his reasonable use drain the surface water into its natural outlet. The plaintiff had the right to drain his land into a natural channel, and to accelerate the flow, as long as he did not drain water which would not have flowed there. The flow to defendant's land was not appreciably increased, and he had no right to impede the flow coming from the upper land. (Duss-Florida)
W70-07600

DWYER V VILLAGE OF GLEN ELLYN (ACTION FOR DAMAGES FOR THE FLOODING OF PLAINTIFF'S LANDS).

41 NE2d 786 (Ill Ct App 1942)

Descriptors: *Illinois, *Cities, Drainage, *Diversion, Sewage, Judicial decisions, Legal aspects, Surface drainage, Tile drainage, Sewers, Drains, Waste water disposal, Drainage water, Municipal wastes, Watercourses (Legal), Competing uses, Damages, Flow, Flooding, Pipes, Snow, Runoff, Overflow, Paving, Flood damage.

An action was brought by plaintiff against defendant city for damages to plaintiff's premises due to the overflow of water diverted upon plaintiff's land. Defendant installed street sewers and paving, thus diverting waters from a natural watercourse upon defendant's dominant estate causing an acceleration of flow and flooding of plaintiff's land. The court held that a municipality having a dominant estate is entitled to drain excess waters from its lands through natural drains on a servient estate. The quantity of water may be increased so long as sewage is not cast upon the servient lands. However, the municipality had no right to divert surface waters or the flow of watercourses from their natural channel into sewers or drains as in the instant case, without compensating the servient proprietor for damages resulting from the overflow. (Barnett-Florida)
W70-07601

CENTRAL INDIANA COAL CO V GOODMAN (ACTION FOR DAMAGES FOR THE WRONGFUL FLOODING OF PLAINTIFF'S LAND).
39 NE2d 484-487 (Ind Ct App 1942).

Descriptors: *Indiana, *Water pollution, *Drainage, *Mine water, Strip mine wastes, Judicial decisions, Legal aspects, Water pollution sources, Acid mine water, Coal mine wastes, Mine acids, Damages, Acid streams, Coal mines, Salts, Mineral water, Chemical properties, Acidity, Odor, Industrial wastes, Relative rights.

Plaintiff owned lands adjacent to defendant's mining operations. A drainage ditch was used to drain excess surface waters from plaintiff's land. Defendant, in the course of its mining operations, caused polluted, acidic mine water to be exposed and

discharged across plaintiff's land. Plaintiff brought action to recover for damages which resulted from this discharge. The court found that the mine water was something potentially damaging if it escaped from defendant's lands, consequently defendant was answerable for all damage which was the natural consequence of its escape. Although plaintiff's land was servient to the flow of surface water from defendant's land, it was not servient to waters contaminated by defendant's acts and cast upon plaintiff's lands through artificial channels. If an upper landowner alters natural conditions so as to change the course of the water or by artificial means increases its volume, he becomes liable for any injury caused thereby. (Barnett-Florida)
W70-07602

AKARD V CITY OF SHREVEPORT (DETERMINATION OF RIPARIAN OWNERS' RIGHTS TO ACCRETION).
200 So 14-16 (La 1941).

Descriptors: *Louisiana, *Accretion (Legal aspects), *Boundaries (Property), *Land tenure, Real property, Water law, Bayous, Gulf coastal plain, Streams, Deltas, Riparian rights, Riparian land, Banks, Judicial decisions, Boundary disputes, Legal aspects, Relative rights.

Plaintiff's father had conveyed to defendant, the City of Shreveport, a triangular tract of land along a bayou. He retained two adjoining lots which plaintiff acquired. Subsequent to the conveyance to the city, an accretion was created in the river along the tracts owned by defendant and plaintiff. Plaintiff brought suit to determine ownership of the alluvion. The court held that the alluvion was to be divided between plaintiff and defendant. When an alluvion is formed in front of riparian property, division is made according to the extent of the front line of each at the time of the formation of the alluvion. Each riparian proprietor acquires such proportion of the alluvial soil as the total extent of his front line bears to the total quantity of the alluvial soil to be divided. (Hubener-Florida)
W70-07606

AMERICAN AGRICULTURAL CHEMICAL CO V COBB (LIABILITY FOR RUPTURED RESERVOIR).
15 So 2d 188-189 (Fla 1943).

Descriptors: *Florida, *Reservoirs, *Flood damage, *Dam failure, Judicial decisions, Flooding, Impoundments, Standing waters, Surface waters, Detention reservoirs, Reservoir leakage, Seepage, Reservoir storage, Settling basins, Overflow, Dam construction, Rupturing, Earthworks, Relative rights, Legal aspects.
Identifiers: Negligence.

Defendant constructed an artificial reservoir or settling basin for the storage of water on land adjacent to plaintiff's property. The dam which held the reservoir broke and caused water, mud and silt to flow onto plaintiff's property. Plaintiff brought action to recover damages, alleging such damages were caused by defendant's negligent construction of the dam. The Florida Supreme Court affirmed the trial court's judgement for plaintiffs, holding that the evidence was sufficient to support a verdict based on negligence. (Douberley-Florida)
W70-07608

AMERICAN SAND AND GRAVEL CO V RUSHING (STREAM BANK EROSION CAUSED BY EXCAVATION ON LOWER RIPARIAN LAND).

184 So 60-63 (Miss 1938).

Descriptors: *Mississippi, *Reasonable use, *Bank erosion, *Flow rates, Mining, Natural streams, Excavation, Relative rights, Legal aspects, Judicial decisions, Water law, Gravels, Soil erosion, Channel erosion, Slopes, Bank stability, Streamflow, Valleys, Accelerated erosion, Flow, Riparian rights, Banks.

Plaintiff owned a tract of land through which ran a stream with many bends and irregular channels. Defendant was a lower, adjoining riparian owner who mined gravel from the stream banks. The defendant's mining operation eventually created a lake which had the effect of increasing the speed of stream flow across the upper land. The banks of the stream on plaintiff's land eroded and caved in over a wide area. In a suit for damages, the court held for defendant. The court stated that neither an upper nor lower riparian owner may make unreasonable use of his land or a stream, but that defendant's operations were reasonable. The court further held that an upper or riparian owner may improve or reclaim his lands by straightening, widening, or deepening the channel of a natural watercourse, even though such improvement causes an increase in the volume and speed of streamflow over abutting lands. Defendant was entitled to this right while engaged in straightening the stream in his operations. (Hubener-Florida)
W70-07611

FOSTER V WEBSTER (PRESCRIPTIVE RIGHT TO OVERFLOW; STATUTE OF LIMITATIONS).
44 NYS2d 153-159 (Sp Ct 1943).

Descriptors: *New York, *Prescriptive rights, *Repulsion (Legal aspects), *Overflow, Diversion, Adjudication procedure, Community development, Easements, Highway beautification, Judicial decisions, Legal aspects, Local governments, Natural flow doctrine, Proprietary power, Public rights, Remedies, Riddance (Legal aspects), Alteration of flow, Diversion structures, Relative rights, Surface runoff, Drainage.
Identifiers: *Statute of limitations.

Defendant superintendent of highways for many years had maintained drainage and diversion ditches parallel to a road running adjacent to plaintiff's land. The ditches caused surface water to flow onto plaintiff's land. Such flowage continued over the years uncontested until the time of this suit wherein plaintiff sought to enjoin defendant from clearing the ditches, which plaintiff had filled. The diverted surface water had apparently begun to erode plaintiff's land. The court held that a municipality may acquire a prescriptive right to divert surface water onto a private person's land, and that the evidence indicated that the statutory period of 15 years of hostile and uninterrupted use had been exceeded. The prescriptive period, however, constituted a statute of limitations and as such could be availed of only if pleaded. A statute of limitations operates only as a bar to a remedy, and, if not pleaded, must be considered waived. Defendant's answer contained no such plea; therefore, the prescriptive right defense could not be considered. Plaintiff's injunction was granted. (Clarke-Florida)
W70-07614

ACQUISITION BY ADVERSE POSSESSION OR USE OF PUBLIC PROPERTY HELD BY MUNICIPAL CORPORATION OR OTHER GOVERNMENTAL UNIT OTHERWISE THAN FOR STREETS, ALLEYS, PARKS OR COMMON.

Annot, 55 ALR2d 554-638 (1957).

Descriptors: *Federal government, *Local governments, *Prescriptive rights, *State governments, Cities, Boundaries (Property), Easements, Legal aspects, Islands, Tidal waters, Legislation, Low water mark, High water mark, Accretion (Legal aspects), Ownership of beds, Patents, Riparian rights, Riparian land, Riprap, Embankments, Relative rights, Navigation, Obstruction to flow, Engineering structures.

The general purpose of this annotation is to consider whether title by adverse possession, or acquisition of an interest less than a title in fee, can be acquired as against federal, state and municipal sovereignties. In the absence of express statutory permission, public lands of the United States cannot be obtained by adverse possession or prescription. Cases annotated have specifically applied this rule with regard to tidelands, accreted land, forest lands, school lands, swamplands and Indian lands. The same general rule applies with regard to property held by the state as to that held by the federal government. Constitutional and statutory provisions applicable to adverse possession, as construed, are examined herein. The same general rules not allowing adverse possession to run against the state and federal governments apply with equal force to land held for public use by a municipality, county or other minor political unit, but not so for lands held alienable and of a proprietary nature. Adverse possession does run against a governmental agency e.g., a drainage district, even when it does not run against the state. (Barnett-Florida)
W70-07615

DRAINAGE--SANITARY DISTRICTS (STRUCTURE, FORMATION AND ADMINISTRATION).
For primary bibliographic entry see Field 04A.
W70-07618

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE OF THE REPORT BY THE COMMISSION ON MARINE SCIENCE, ENGINEERING AND RESOURCES).
Natural Resources Lawyer, Vol 2, No 4, p 412-441, Nov 1969. 30 p, 17 ref.

Descriptors: *Resource development, *Continental shelf, *Marine geology, *Exploitation, Legal aspects, Political aspects, United Nations, Sea water, Oceans, Organizations, Administrative agencies, Continental margin, Mineralogy, Geological surveys, International law, International waters, Treaties, Coasts, Federal government, Oil, Exploration, Technology, Natural gas, Fresh water, Beds.

A critique of a portion of the Report by the Commission on Marine Science, Engineering and Resources, this article deals with non-living marine resources beneath the sea and emphasizes the legal and institutional aspects of the Commission's Report. Two principal subject headings are: (1) the development of non-living marine resources and (2) an international legal-political framework for exploring and exploiting seabed mineral resources. Included under the first heading are considerations of petroleum, natural gas, hard minerals, fresh water, and pre-investment geological surveys. Under the second heading the critique considers international objectives regarding mineral resources, the existing international framework, the Treaty of the Continental Shelf, the regime behind the treaty shelf, relations between government and private enterprise, and a suggested course of interim action before establishment of a new framework. An appendix to the critique contains a resolution prepared by the American Bar Association. (See also W70-07625 thru W70-07627). (Duss-Florida)
W70-07624

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE: THE DEVELOPMENT OF NON-LIVING MARINE RESOURCES).
Natural Resources Lawyer, Vol 2, No 4, p 413-418, Nov 1969. 6 p, 2 ref.

Descriptors: *Resource development, *Exploitation, *Marine geology, *Continental shelf, Legal aspects, Administrative agencies, Federal government, Oil, Mineralogy, Natural gas, Mining, Fresh water, Pipelines, Technology, Planning, Management, Geological surveys, Costs, Investment, Exploration, Sea water, Coasts, Leases, Industries.

The Report of the Marine Science Commission divides non-living marine resources into four categories: oil, gas, hard minerals and fresh water. The Report notes the significance of offshore oil development, the need for exchange of technical information regarding this source, and the need for United States leasing and regulatory policies to

reflect all aspects of national interests. This critique agrees generally with the Report but would include all mineral industries in the exchange of technical information and would give private industry a greater voice in decision making. The Report makes several constructive suggestions designed to encourage exploration and development of offshore natural gas. The suggestions relate to the regulation of pipelines by the Federal Power Commission. Regarding hard minerals, the Report notes the relative infancy of ocean mining, the high costs of exploitation, the need for technological development, and the necessity for state and federal incentives to encourage exploration and development. One major incentive would be to award development rights on the outer continental shelf without requiring competitive bidding. Concerning fresh water, the Report recommends continued efforts by the Department of the Interior in the area of desalination. This critique cites the need for cooperation between government and private industry in desalination, but generally agrees with the Commission's report. (See also W70-07624). (Duss-Florida)
W70-07625

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE: INTERNATIONAL LEGAL-POLITICAL FRAMEWORK FOR SEABED MINERAL RESOURCES).
Natural Resources Lawyer, Vol 2, No 4, p 418-430, Nov 1969. 13 p, 10 ref.

Descriptors: *International law, *Exploitation, *Continental shelf, *Treaties, Resource development, Legal aspects, Sea water, Continental margin, Continental slope, Technology, Exploration, Mineralogy, International waters, Natural resources, Subsoil, Marine geology, Beds, Coasts, Federal government, International commissions, Boundaries (Property), Research and development.

The Report of the Marine Science Commission takes the position that the existing international framework for exploitation of seabed mineral resources is inadequate. The present regime is based on the Convention on the Continental Shelf which is deficient in that it deters development of mineral resources. Development is discouraged because: (1) there is an uncertainty as to the seaward boundary of the continental shelf; and (2) beyond the boundary line existing principles are insufficient to assure security and protect national and international interests. To improve this situation the Report urges that the United States initiate a new international agreement to redefine the continental shelf and to provide more definite areas of control. This Critique of the Report disagrees with the Commission's position. While finding it laudable to encourage scientific and technical research, secure the rights of all nations to resource development, and avoid international conflict, it does not agree that the existing Convention is too vague in defining the limits of the continental shelf. The Critique finds that the concept of adjacency in defining the limits of the continental shelf best promotes United States interests. Moreover, its possible extensiveness is an asset since a new international agreement is unlikely. A formal international agreement is not preferable anyway as agreement could be achieved by parallel declarations of interested states announcing a uniform interpretation of the existing Convention agreement. (See also W70-07624). (Duss-Florida)
W70-07626

NON-LIVING RESOURCES OF THE SEA (A CRITIQUE: INTERNATIONAL LEGAL-POLITICAL FRAMEWORK FOR SEABED MINERAL RESOURCES), INTERNATIONAL REGISTRY AUTHORITY AND CONCLUSIONS.
Natural Resources Lawyer, Vol 2, No 4, p 430-441, Nov 1969. 12 p, 4 ref.

Descriptors: *International law, *Exploitation, *Continental shelf, *International commissions, Resource development, Legal aspects, Oceans, Sea water, Continental margin, Continental slope, Technology, Exploration, Mineralogy, United Nations, Investment, Administrative agencies, Costs, United States, Natural resources, Beds, Coasts, Boundaries (Property), Marine geology, Federal government.

The Report of the Marine Science Commission proposes: (1) the creation of an international registry authority to register nations' claims for exploration and exploitation of the continental shelf; and (2) an international fund to collect revenue derived from exploitation of resources. The Report also sets forth: (1) the powers and duties of registering states; (2) the policing functions of the registry authority; (3) procedures for the settlement of disputes; and (4) proposals for the creation of an intermediate zone for exploitation beyond the shelf limit. The registry authority would be a part of the United Nations but would be autonomous. This Critique of the Report is generally favorable to these suggestions. However, it would alter some of the procedures for registering claims, insulate the authority from control by the General Assembly, restrict the authority's right to fix payment to the international fund, and would curtail creation of an intermediate zone. The Critique also contains recommendations concerning creation of a deep sea international regime. Regarding the United States specifically, the Commission Report recommends that the Department of Interior register domestic claims. The Critique agrees with this in principle. (See also W70-07624). (Duss-Florida)
W70-07627

APPLICATION OF FORD (ASSIGNMENT OF EMINENT DOMAIN COMPENSATION).
304 NYS2d 773-778 (1969).

Descriptors: *New York, *Administrative agencies, *Condemnation, *Eminent domain, Judicial decisions, Legal aspects, Riparian rights, Diversion, Remedies, Impoundments, State governments, Water supply, Delaware River, Tributaries, Administration, Adjudication procedure, State jurisdiction, Planning, Water delivery, Water demand, Water management (Applied), Water shortage.

Pursuant to statute in 1952, New York City, under eminent domain powers, obtained the right to divert the waters of the Neversink River and obtained certain lands necessary for this purpose. Subsequent to this date, and before compensation by the City, an owner of such lands appropriate by the city in 1952, conveyed title to grantee-claimants in this action. No assignment of the grantor's claim for compensation against the city was given. Upon the grantor's death his estate sought damages for the lands appropriated in 1952. The grantees by the subsequent conveyance sought to intervene by motion. The issue to be resolved was whether the fee vested in the City prior to the owner's conveyance to grantees. If so, the grantee's allegations were groundless as the owner had no title to convey and had made no assignment of the claim. The court held that failure to adhere to procedural technicalities in the New York Water Supply Act in appropriating the property in 1952 were insignificant and in no way defeated the city's title taken pursuant to that Act. The grantee's motion was denied. (Barnett-Florida)
W70-07628

MATTHEWS V BAGNIK (RIPARIAN RIGHTS IN NONNAVIGABLE LAKES).
41 A2d 875-878 (Penn 1945).

Descriptors: *Pennsylvania, *Boundary disputes, *Ownership of beds, *Non-navigable waters, Judicial decisions, Riparian rights, Water rights, Banks, Prescriptive rights, Relative rights, Riparian land, Riparian waters, Boundaries (Property), Lakes, Ponds, Lake beds, Beds under water, Fishing, Real property, Easements, Legal aspects.

Plaintiff owned a tract of land bounded on one side by a non-navigable private lake. Plaintiff asserted ownership of certain portions of the lake by prescription and alleged riparian rights to the center of the lake. The court found that the deed described the land by natural boundaries, and since the lake was named as a boundary plaintiff had no right to claim property beyond the shore line. The court held that in the case of a non-navigable lake, where the land covered by water is owned by others and no riparian rights attach to the property bordering on the lake, an attempt to exercise such rights is a trespass as if on dry land. Ownership of land bordering the lake did not give any rights of ownership in the lake itself. The court further held that plaintiff gained no rights by prescription. The rights of the owners of the lake had been asserted against the trespass of plaintiff numerous times. The fact that plaintiff did enter the lake to fish did not give plaintiff title or an easement thereto. (Douberley-Florida)
W70-07634

FRAZIER V SHANTZ REAL ESTATE AND INVESTMENT CO (TITLE TO ALLEGED ACCRETION).
123 SW2d 124-133 (Mo 1938).

Descriptors: *Missouri, *Boundaries (Property), *Accretion (Legal aspects), *Boundary disputes, Surveys, Judicial decisions, Legal aspects, Relative rights, Riparian rights, Water law, Rivers, Water rights, Land forming, Real property.

Plaintiff brought actions of ejectment and to quiet title against defendant, an adjacent landowner. The land in controversy bordered the Meramec River. Defendant claimed title to the land as an accretion to riparian land patented to his predecessor in title. The east-west center line of the survey section formed the common boundary of the parties' adjoining lots. From the original government survey it was unclear in which half of the survey section the river was located. All conveyances in plaintiff's chain of title purported to convey all land north of the Meramec River in the south half of the survey section. The court could not determine whether accretions had, in fact, formed. Therefore title to the land in controversy was adjudged to be in plaintiff. (Cuevas-Florida)
W70-07636

GOODLOE V CITY OF RICHMOND (PRIVATE WATER RIGHTS).
113 SW2d 834-838 (Ky 1937).

Descriptors: *Kentucky, *Easements, *Water contracts, *Water supply, Water allocation (Policy), Legal aspects, Boundaries (Property), Contracts, Judicial decisions, Local governments, Preferences (Water rights), Public rights, Resource allocation, Social needs, Water rights, Well permits, Supply contracts, Water quality, Relative rights, Prescriptive rights, Public lands.

During a severe water drought, plaintiff laid a water pipe line across two city streets from a well to his garage and pumped water through it to supply the needs of his business. The city of Richmond and the water company joined in a suit against plaintiff to enjoin him from further use of the pipe line. The trial court held that because of the water shortage and defendant water company's failure to furnish an adequate supply, plaintiff could continue to use the water line as long as the emergency existed. Two years later, after the drought had ended, the city severed the pipe line. Plaintiff sued the city for injunctive relief and damages, and he sued the water company for alleged damages arising from breach of a contract wherein the water company promised to purchase water from plaintiff's well in excess of his needs, provided that the water met the approval of the state Board of Health. The court held in the first instance that the plaintiff's invasion of the streets was in fact a trespass abinitio and that the lower court's initial refusal to compel plaintiff to cease using the pipe line was purely a matter of

grace. Plaintiff's only injury by defendant water company consisted of defendant's failure to supply a sufficient quantity of water for plaintiff's business needs, and damages arising therefrom were never proved. Plaintiff's personal contract with defendant water company never became operative because well water was never approved by the state Board of Health. (Clarke-Florida)
W70-07638

BLAIN V CRAIGIE (RESERVATION OF RIPARIAN RIGHTS).
293 NW 745-747 (Mich 1940).

Descriptors: *Michigan, *Riparian rights, *Riparian land, *Docks, Judicial decisions, Artificial use, Banks, Ownership of beds, Reasonable use, Recreation, Relative rights, Remedies, Riparian waters, Water law, Legal aspects, Water utilization, Land tenure, Boundaries (Property), Lakes.

Lands on a lake, including 30 feet of property extending from the low-water mark of the lake, were deeded to defendants. There were no specific reservations of riparian rights by the conveyor. Defendants erected a hotel on the property and constructed a dock extending 108 feet into the lake. Plaintiff, son of the conveyor, contended that recreational activity connected with the dock interfered with his use of an island lying 700 feet from the shore. Plaintiff claimed that extension of the dock further than 30 feet constituted trespass, and he sought removal of that portion of the dock. The court held that conveyance of property bounded by a watercourse carries with it, in the absence of a reservation, the riparian rights. A reservation of riparian rights is not presumed. The conveyance of 30 feet of land into the lake was not a reservation of rights in the water beyond the 30 feet. (Dye-Florida)
W70-07641

HOLDA V GLICK (MISTAKE IN CONVEYANCE OF MILLPOND PROPERTY).
312 Mich 394, 20 NW2d 248-252 (Mich 1945).

Descriptors: *Michigan, *Ownership of beds, *Boundary disputes, *Land tenure, Riparian rights, Judicial decisions, Legal aspects, Water law, Beds, Beds under water, Boundaries (Property), Ponds, Real property, Land, Land reclamation, Land forming, Landfills, Relative rights, Ponds, Contracts.

Defendant, plaintiff's vendor, purchased property together with all rights in an adjacent millpond. Plaintiff purchased the property by a conveyance which failed to mention the millpond. Plaintiff and a corporation owning adjacent property filled portions of the millpond, creating usable land, and the remainder was subsequently drained. A dispute arose between plaintiff and the corporation as to ownership of the millpond land. Plaintiff sought reformation of the land contract with defendant on the grounds that defendant represented to plaintiff prior to the sale that the millpond was part of the property to be conveyed and that the pond was excluded from the deed by mutual mistake. Defendant denied that there was a mistake. The court held that, as the vendor did not reserve rights in the pond, they passed with title to the property. Nevertheless, reformation required plaintiff to prove mistake by clear and convincing evidence. Plaintiff failed to carry the burden of proof and reformation was denied. (Dye-Florida)
W70-07643

INHABITANTS OF HOLLISTON V HOLLISTON WATER CO (EXTENT OF WATER COMPANY'S EMINENT DOMAIN POWERS--DEFINITION OF STREAM AND SPRING).
27 NW2d 194-197 (Mass 1940).

Descriptors: *Massachusetts, *Streams, *Water works, *Eminent domain, Springs, Judicial decisions, Legislation, Administration, Cities, Real property, Domestic water, Running waters, Bodies of water, Confined water, Fresh water, Spring waters, Subsurface waters, Water sources, Water supply, Water wells, Groundwater, Pumping, Banks, Percolating waters, Legal aspects.

In a dispute between a municipality and a water company, the company claimed title to a tract of land by eminent domain. The court found that the water company's powers were limited by statute to taking land only if that land consisted of or contained a spring or a stream. The company used the land to drill a well from which water was brought to the surface by pumps. The court held that a stream implied a flow in an ascertainable direction between banks and within limits. Since the percolating waters were held not to be a stream, the land could not be said to contain a stream. The court held that a spring issued forth from the ground in such a manner as to disclose the presence of water upon the surface. Percolating water brought to the surface from beneath an impervious layer of clay with a pump was not a spring within the meaning of the statute. Since the land contained neither a stream nor a spring, the taking by the water company was held to be unlawful. (Douberley-Florida)
W70-07645

EARHART V ROSENWINKEL (PROPERTY LINE DISPUTE OVER LAND ADJACENT TO LAKE).
25 NE2d 268-273 (Ind Ct App 1940).

Descriptors: *Indiana, *Boundaries (Property), *Boundary disputes, *High water mark, Judicial decisions, Riparian rights, Real property, Lakes, Non-navigable waters, Bodies of water, Ownership of beds, Beds under water, Shores, Ponds, Water rights, Banks, Riparian land, Legal aspects, Relative rights.

In a suit to quiet title to land adjacent to a non-navigable lake, a dispute arose over a land description which used a section corner, an iron stake and willow tree, and the ordinary high water mark of the lake as starting points for a metes and bounds description. The court held that where the intent of the parties is not otherwise stated, there is a presumption that the grantee of land bounded by a non-navigable stream or river acquires land title to the center or thread of the water. The presumption was said to apply unless the contrary clearly appears or is necessarily implied, and would have applied in this case if artificial monuments had not been used in the description. The court stated that natural monuments take precedence over inconsistent artificial monuments in the description. Further, it was presumed that when monuments are mentioned in the deed as occupying the bank of a river, the lines should be continued to the water's edge, even if that is beyond the monument itself. The court held that the description in the deed carried the title, with riparian rights, at least to the water line of the lake. (Douberley-Florida)
W70-07646

DALE V BEDAL (IMPLIED EASEMENT FOR SEWAGE DISPOSAL).
25 NE2d 175-176 (Mass 1940).

Descriptors: *Massachusetts, *Easements, *Septic tanks, *Subsurface drainage, Judicial decisions, Contracts, Real property, Land use, Disposal, Sewage disposal, Soil disposal fields, Waste disposal, Conduits, Sewers, Closed conduits, Outlets, Pipes, Drainage, Prescriptive rights, Legal aspects.

Plaintiff had owned two adjacent parcels of land, and the sewage from plaintiff's house was piped to a reception tank on the other parcel. Defendant purchased the latter parcel from plaintiff without knowledge of the tank or the pipeline. Plaintiff sought to establish a right by necessity to maintain and use the underground receptacle on defendant's land. The court found that there may be an easement of drainage by necessity, but that implied easements do not arise out of necessity alone. Since neither plaintiff nor the physical situation of the premises gave notice to defendant of the existence and use of the tank, the court held that an easement would not be implied from the terms of the conveyance. Implied terms could not be imported into the conveyance because of the needs of one of the parties of which the other party had neither knowledge nor notice. Plaintiff's action was denied. (Douberley-Florida)
W70-07647

HARRISON V POLI-NEW ENGLAND THEATRES, INC (LIABILITY FOR ICE IN FRONT OF BUSINESS).
23 NE2d 99-101 (Mass 1939).

Descriptors: *Massachusetts, *Ice, *Buildings, *Drains, Judicial decisions, Snow, Highway icing, Freezing, Land development, Land use, Landscaping, Structures, Roofs, Runoff, Surface runoff, Discharge (Water), Snowmelt, Surface waters, Natural flow, Channels, Drainage effects, Repulsion (Legal aspects), Riddance (Legal aspects).

Plaintiff slipped on ice on the sidewalk in front of defendant's place of business and sued for damages. Plaintiff alleged that the ice was formed from water dripping from defendant's marquee. The court stated that a landowner has the right to construct buildings on his property even if the natural course of surface water is changed, but he had no right to collect surface water into an artificial channel and discharge it upon the way in a greater quantity than would have been discharged but for the building. The court affirmed the jury's finding that defendant was negligent in maintaining a defective marquee from which water dripped and froze upon the sidewalk. (Douberley-Florida)
W70-07648

6F. Nonstructural Alternatives

FLOOD PLAIN INFORMATION, ST. CHARLES RIVER, PUEBLO, COLORADO.
Corps of Engineers, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04A.
W70-07161

FLOOD PLAIN INFORMATION, MINGO CREEK, TULSA, OKLAHOMA.
Corps of Engineers, Tulsa, Okla.
For primary bibliographic entry see Field 04A.
W70-07162

RIVER FORECASTING TECHNIQUES IN KOREA,
Ministry of Construction, Seoul (South Korea).
For primary bibliographic entry see Field 02E.
W70-07176

FLOOD PLAIN INFORMATION, PENNSAUKEN CREEK AND SOUTH BRANCH, BURLINGTON AND CAMDEN COUNTIES, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W70-07192

FLOOD PLAIN INFORMATION, LITTLE LA GRUE BAYOU, HOLT QUERTERMOUS AND PRICE BRANCHES, DEWITT, ARKANSAS.
Corps of Engineers, Memphis, Tenn.
For primary bibliographic entry see Field 04A.
W70-07194

MISSISSIPPI RIVER FLOOD PLAIN INFORMATION, CASSVILLE, WISCONSIN.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-07197

FLOOD PLAIN INFORMATION, WABASH RIVER AND WILDCAT CREEK, VICINITY OF LAFAYETTE AND WEST LAFAYETTE, TIPPECANOE COUNTY, INDIANA.
Corps of Engineers, Louisville, Ky.
For primary bibliographic entry see Field 04A.
W70-07212

FLOOD PLAIN INFORMATION, DAN AND SANDY RIVERS AND SANDY CREEK, DANVILLE, VIRGINIA.
Corps of Engineers, Wilmington, N.C.
For primary bibliographic entry see Field 04A.
W70-07347

FLOOD PLAIN INFORMATION, CEDAR RIVER AND TRIBUTARIES, AUSTIN, MINNESOTA.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-07372

FLOOD PLAIN INFORMATION, ROCK RIVER, WINNEBAGO, ILLINOIS.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W70-07373

SPECIAL FLOOD HAZARD INFORMATION REPORT, BARTON CREEK, AUSTIN, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 04A.
W70-07374

THE TECHNICAL SERVICES DESIGN PROBLEM,
Northwestern Univ., Evanston, Ill.
Kenneth J. Cypra.
In: Technical Services for Urban Flood Plain Property Models: Problem Formulation and Study of Property Manager Receptivity, Evanston, Illinois, Chapter I, PhD dissertation, 1970, p 1-28. 1 fig, 1 tab, 10 ref.

Descriptors: *Non-structural alternatives, *Communication, *Community development, *Education, *Flooding, *Flood plain zoning, *Floodproofing, *Flood protection, *Political aspects, Local governments, Federal government, State governments, Flood plain insurance, Abatement, Design criteria, Design, Tennessee Valley Authority Project, Regions, Decision making, Planning, Programs, Legal aspects.
Identifiers: *Flood plain managers, *Flood plain management, *Property managers, *Homeowners, *Technical services program, *Technical service, *Technical assistance, *Efficacy, *Expectation, *Information, *Flood hazard, *Proper use, *Receptivity, *Compliance, Flood warnings, Implementation, Alternatives.

This chapter treats the technical services design problem for flood plain managers. Flood plain managers are defined as property owners of flood plain lands. The chapter is concerned with two main topics: the programmatic framework; and major design factors. The services are characterized as education, information and technical assistance, and aim toward 'proper use' of the flood plain. 'Proper use', defined as a combination of community goals, individual goals and the local flood hazard, is the basis for the local flood plain management (FPM) effort. In designing a technical services program to fit the FPM effort, three objectives are identified: fostering hazard awareness; encouraging efficacy for property manager action; and complementing a program of public control and regulation by facilitating property manager compliance. A table of selected properties of technical service alternatives relate these objectives to the service possibilities. Two design criteria are considered: the overall FPM effort; and receptivity of individual property managers. The overall FPM effort might range from no legal restrainists to total regulation. Different alternatives would be needed accordingly. Receptivity depends greatly on perception of flood hazard and efficacy. This can be effected by the dissemination of relevant services which are both timely and effectively communicated. (Richmond-Chicago)
W70-07547

6G. Ecologic Impact of Water Development

A BIBLIOGRAPHY OF BOOKS ON THE ENVIRONMENT -- AIR, WATER AND SOLID WASTES,
Toledo Univ., Ohio. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 10.
W70-07190

07. RESOURCES DATA

7A. Network Design

THE ACQUISITION OF DATA FOR FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 02E.
W70-07173

THE REPRESENTATIVE BASIN CONCEPT IN AUSTRALIA.
Australian Water Resources Council, Canberra.

Australian Water Resources Council Hydrological Series No 2, 1969. 24 p, 5 fig, 1 map, 1 tab, 19 ref, append.

Descriptors: *Rainfall-runoff relationships, *Stream gages, *Mathematical models, *Rainfall disposition, Topography, Geology, Land use, Vegetation effects, Parametric hydrology, Hydrogeology, Hydrologic data, Unit hydrographs, Hydrograph analysis.
Identifiers: *Australia, Representative basins.

In order to supplement the accelerated stream gaging program which is currently being carried out by the State and Commonwealth Governments, the Australian Water Resources Council has initiated a program of selection, instrumentation and operation of nearly a hundred representative basins throughout Australia. The objectives are to provide a better basis for estimation of runoff in ungaged catchments, and a better understanding of the hydrological cycle in general. The basis for selection of the basins, and proposals for the collection and analysis of data from them are outlined. To provide an objective and scientific basis for the selection of the representative basins, a map of Australia showing 'Relief and Land Form' was compiled, and on this the boundaries of 11 broad climatic zones, based on the amount and seasonal distribution of rainfall, were superimposed. On this basis it appeared that a total of 93 catchments would be expected to provide data that would be broadly representative of the whole of Australia. (Knapp-USGS)
W70-07191

DISTRIBUTION OF A HYDROLOGIC NETWORK IN IRRIGATED AND DRAINED AREAS,
K. S. Kabanova.
Transl. from Trudy Gos Gidro Instituta, No 164, p 56-63, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 594-600, 1968. 1 fig, 2 tab, 2 ref.

Descriptors: *Hydrologic data, *Data collections, *Network design, Runoff, Irrigated land, Drainage districts, Rivers, Discharge (Water), Stations, Hydraulic structures.
Identifiers: *USSR, Zeravshan River, Pripyat' River.

Placement of runoff stations along the length of a river must allow determination of runoff in individual reaches. Variation in water discharge along the river course can result from natural or artificial modifications of the environments. The distribution of hydrologic stations along the Zeravshan River, USSR is described. Large water quantities from this river are used for irrigation. Distribution of a hydrologic network in a large drainage basin must consider: (1) use of all possible stations with long series of observations; (2) determination of runoff; (3) study of water regime in reaches above and below dams and other hydraulic structures; (4) water balance determination in reservoir areas based on hydrometric data. An analysis of the existing hydrologic network in the Pripyat' River basin showed that the number of stations should be increased by 40%. (Carstea-USGS)
W70-07198

PRINCIPLES FOR THE DISTRIBUTION OF INFORMATION HYDROLOGIC POSTS,
R. A. Shestakova.
Transl. from Trudy Gos. Gidrol Instituta, No 164, p 49-55, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 588-593, 1968. 2 fig, 1 tab, 9 ref.

Descriptors: *Runoff forecasting, *Streamflow forecasting, *Network design, Gaging stations, Rivers, Correlation analysis, Flow, Tributaries.
Identifiers: *USSR, Dnieper River, Oka River, Sula River, Vilyny River, Kiev.

Runoff forecasting for small rivers is important for planning and operating hydroelectric power stations. Forecasting spring runoff on the Dnieper River at Kiev uses multiple correlation methods for forecasting the water flow at the outlet stations. The optimum catchment area of small rivers differs for different hydrologic stations and depends on the catchment area of the outlet station, water regime, nature of the predicted element, and computation time interval. It is recommended that: (1) a correlation analysis be made in order to select the minimum number of stations; and (2) hydrometric stations be planned on tributaries with a relative catchment area obtained from an analysis of data for rivers situated in different physiographic regions. (Carstea-USGS)
W70-07199

PRINCIPLES FOR DISTRIBUTION AND PROSPECTS FOR DEVELOPMENT OF A HYDROLOGIC NETWORK,
I. F. Karasev.
Transl. from Trudy Gos Gidrol Institute No 164, p 3-36, 1968. Soviet Hydrology: Selected Papers, Issue No 6, p 560-588, 1968. 3 fig, 2 tab, 23 ref.

Descriptors: *Hydrologic data, *Data collections, *Network design, Stations, Runoff, Lakes, Reservoirs, Water levels, Rivers, Forecasting.
Identifiers: *USSR.

The present status of the hydrologic network of the USSR and proposals for its development based on modern concepts of hydrologic processes are discussed. The existing network consists of about 6500 runoff stations. In addition, stations for measuring lake and reservoir water levels increase the overall number of stations to 8300. The number of stations in the European USSR is close to an optimum, although a redistribution may be desirable. A sequence for establishing an optimum hydrologic network is discussed. In the first stage (1967-1972) about 1060 new stations are to be established, and in the second stage (1973-1982) another 1230 stations are planned. (Carstea-USGS)
W70-07205

RESEARCH ON DATA AND ANALYTICAL SYSTEMS FOR PREPARING NATIONAL WATER ASSESSMENTS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W70-07326

HYDROLOGIC INVESTIGATIONS,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
L. B. Davies.
Engineering Journal (Canada), Vol 52, No 10, p. 48-56, Oct 1969. 9 p, 9 fig, 1 tab, 6 ref.

Descriptors: *Hydrology, *Hydrologic data, *Investigations, Snowmelt, Streamflow, Field investigations, Foreign projects, Hydrometeorological station, Mass curves, Storage capacity, Runoff, Reservoirs, Flood peaks, Project planning, Gaging stations, Flood routing, Spillway design flood.
Identifiers: *Portage Mountain Dam, *Portage Mountain Powerplant, Canada, W A C Bennett Dam (Canada), Canada, Flood hydrology.

The design of the Portage Mountain Development in Canada involved extensive studies of the hydrology of a 27,000-sq-mi drainage basin. A hydrometeorological network comprising snow courses, streamflow gages, and meteorological stations was set up to collect data used to determine a spillway design flood, reservoir filling curves, and firm energy outputs. Other determinations to be made included: (1) the average runoff and the probable variation in runoff over the life of the project, based on the historic records of the Peace River at Hudson Hope and of adjacent streams; (2) the storage volume of the reservoir created by the construction of W A C Bennett Dam; (3) the annual variation of runoff from snowmelt and precipitation, leading to the development of forecasting methods; (4) the magnitude of floods of critically great volume leading to the design of a spillway large enough to permit the passing of these floods without causing reservoir levels to rise beyond the maximum elevation permitted for safety; and (5) economic use of the water power. (USBR)
W70-07426

7B. Data Acquisition

SOME COMMENTS ON REFLECTANCE MEASUREMENTS OF WET SOILS,
National Environmental Satellite Center, Washington, D.C. Satellite Experiment Lab.
Walter G. Planet.
Remote Sensing of Environment, Vol 1, No 2, p 127-129, March 1970. 3 p, 3 fig, 1 tab, 5 ref.

Descriptors: *Remote sensing, *Soil moisture, *Optical properties, Light, Refractivity, Heat balance.
Identifiers: Soil moisture sensing.

The observed visual darkening of wet natural soils is ascribed to total internal reflections of the reflected radiation in a water layer covering the soil. If the index of refraction of the liquid and the reflectance of the sample when dry are known, it is possible in principle to predict the visual reflectance of a saturated soil sample. Laboratory measurements were performed to evaluate this; samples of varying reflectance and liquids of different indices of refraction were used. The results support the explanation and indicate conditions where it should be used with caution. (Knapp-USGS)
W70-07155

SNOWFIELD MAPPING WITH K-BAND RADAR,
Kansas Univ., Lawrence. Remote Sensing Lab.
William P. Waite, and Harold C. MacDonald.
Remote Sensing of Environment, Vol 1, No 2, p 143-150, March 1970. 8 p, 10 fig, 1 tab, 13 ref.

Descriptors: *Remote sensing, *Snowpacks, *Snow Surveys, *Radar, Snow cover, Surveys, Investigations, Instrumentation, Glaciers, Ice.
Identifiers: K-band radar.

Analysis of K-band imagery from several snowfield areas in the United States suggests that the distribution of perennial snow results in an anomalously high return. In contrast to normal snow survey methods, it appears feasible to map the areal extent of old snow areas irrespective of most weather conditions, and even when covered with new-fallen snow. The observed differences in signal return between the metamorphosed snow and the surrounding terrain do not seem explainable simply by moisture content. It is suggested that the significant increase in signal return of old snow arises from volume scattering. The structure of the metamorphosed snow plays a much more important role than affecting the form factor of the dielectric mix of ice and air. A considerably more complex model must be assumed for the interpretation of microwave return from snowfields. (Kanpp-USGS)
W70-07157

PHOTOGRAPHIC MONITORING OF SHORELINE MOVEMENT,
Corps of Engineers, Wilmington, N.C.
John D. Weber.
Shore and Beach, Vol 38, No 2, p 36-38, April 1970. 3 p, 1 fig.

Descriptors: *Beach erosion, *Sediment transport, *Aerial photography, Remote sensing, Photogrammetry, Dunes, High water mark, Coasts, Geomorphology, Shores.
Identifiers: Shoreline movement.

A study was conducted at the U.S. Army Engineer District, Wilmington, N.C., South Atlantic Division, to determine the feasibility of developing a system of monitoring shoreline movements through the use of aerial photography. A unique monitoring process is based on comparing the distances from fixed reference points to index points on the beach taken from separate sets of aerial photographs. This type of system was found to be feasible only if an index point on the photo which represents the actual location of the beach at the time of photography can be located. There are usually three index points available on a typical beach profile: The seaward toe of the dune system called the dune line; the maximum extent of wave run-up (called the high-water line); and the land-water boundary (called the water line). The dune line is an excellent indicator of beach migration and can provide valuable information in relation to the stability of a particular reach of shoreline. Because of the impracticability of considering the combined effect these factors would have on the location of the high water line, it was decided not to use the so-called high water line as an index point in developing the monitoring system. The water line, similar to the other index points discussed so far, is not ideal but appears to be the most practical and reliable point. The most important factors are to obtain the photography at a time and in such a manner as to eliminate as many of the variables as possible and to obtain the necessary field data immediately after the photography is taken. (Knapp-USGS)
W70-07164

DETERMINATION OF GROUNDWATER AGES BY THE TRITIUM -- 3 He METHOD,
Institute of Precambrian Geology and Geochronology, Leningrad (USSR); and All-Union Petroleum Geology Exploration Inst.
I. N. Tolstikhin, and I. L. Kamenskiy.
Transl. from Geokhimiya, No 8, p 1027-1029, 1969. Geochemistry International, Vol 1969, No 7-8, p 810-811, April 1970. 7 ref.

Descriptors: *Radioactive dating, *Tritium, *Helium, *Groundwater, Radioisotopes, Radiochemical analysis, Geochemistry, Groundwater movement.
Identifiers: Groundwater dating, USSR.

Determining the age of groundwaters from their tritium contents is difficult because of the large variations in the tritium content of precipitation. Tritium decays to He-3 and it is suggested that the He-3 accumulation in the water could be used to measure the decayed tritium, so the initial tritium content can be found. He-3/He-4 and He/Ne ratios could be used to correct for atmospheric He contributions, or detect He from older admixed waters. (Knapp-USGS)
W70-07168

SOME POTENTIAL APPLICATIONS OF METEOROLOGICAL SATELLITES IN FLOOD FORECASTING,
Bureau of Meteorology, Melbourne (Australia).
A. F. Rainbird.
Proceedings of WMO/Unesco Symposium on Hydrological Forecasting, held at Queensland, Australia, 1967: World Meteorological Organization Technical Note No 92, p 73-80, 1969. 8 p, 5 fig, 12 ref.

Descriptors: *Flood forecasting, *Data collections, *Satellites (Artificial), *Remote sensing, Synoptic analysis, Reviews, Surveys, Aerial photography, Infrared radiation, Meteorological data, Hydrologic data.
Identifiers: Meteorological satellites.

Meteorological satellites offer a number of advantages as observing platforms. They are able to view every point on Earth periodically; they make possible the rapid collection and read-out of data; and, whenever an element can be measured directly by satellite-mounted sensors, they eliminate the need to interpolate data between the point samples of conventional observing networks. (Knapp-USGS)
W70-07174

NEW ENRICHMENT AND MULTIPLE SAMPLING PROCEDURES TO INVESTIGATE RADIOACTIVE TRACER MIXING IN A SMALL RIVER,
Agricultural Research Council of Central Africa, Salisbury (Rhodesia).
P. R. B. Ward, and P. Wurzel.
Journal of Hydrology, Vol 6, p 265-276, 1968. 12 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Tracers, *Mixing, *Tracking techniques, *Radioactivity techniques, *Streamflow, Floats, Current meters, Instrumentation, Radioisotopes, Diffusion, Dispersion, Sampling, Solutes, Aqueous solutions.
Identifiers: Longitudinal dispersion.

Recent work in the measurement of flow in rivers and canals with radioactive tracers has stressed the importance of the use of many sampling points. A thorough investigation of the lateral distribution of the tracer at sampling stations is necessary. Invariably, it is the distance required for complete lateral dispersion of tracer which determines the mixing distance in natural streams. The use of floating samplers was found to be most satisfactory in an investigation of lateral mixing in a small stream. The small size of the samplers, 1000 ml, ensured that comprehensive investigations using many sampling points were undertaken without difficulties of handling after the experiment. A new method of concentration of radioisotopes using paper evaporation of the samples ensured that the tracer was counted with high detection sensitivity despite the small volume of samples. Accurate measurement of the tracer concentration as a function of time at two stations allowed the tracer passage curves to be reliably determined. Use of this data enabled the longitudinal dispersion coefficient to be calculated by two methods. (Knapp-USGS)
W70-07196

ARGON 37, ARGON 39, AND KRYPTON 81 IN THE ATMOSPHERE AND TRACER STUDIES BASED ON THESE ISOTOPES,
Bern Univ. (Switzerland). Physikalisches Institut.
For primary bibliographic entry see Field 02K.
W70-07248

RECENT RESEARCH TO DETERMINE REAERATION COEFFICIENT,
Institute of Hydrotechnical Research, Bucharest (Rumania).
M. Negulescu, and V. Rojanski.
Water Research, Vol 3, p 189-202, 1969. 11 fig, 3 tab, 14 ref.

Descriptors: *Streams, *Reaeration, *Biochemical oxygen demand, Oxygenation, Analytical techniques, Mathematical studies, Equations, Rivers.
Identifiers: *Reaeration coefficient, Stream hydraulics, Oxygen absorbtion, Oscillograms, O'-Connor-Dobbins equation, Krenkel-Orlob equation, Reynold's number.

Investigation was conducted in a 20- by 30-centimeter, 20-meter-long channel constructed of sheet steel. Water was circulated by a motor-driven propeller pump. Determination of reaeration coefficient by chemical method yielded the following regression equation (expressed in logarithmic form): log k-sub-2 = 0.85 log (V/h) + log 4.74, where V is mean velocity of water (ft/sec), and h is mean depth (ft). The coefficient computed electronically was expressed by the relation log D-sub-L = 0.78 log (V/h) + log 310. The value of log k-sub-2, in turn, was equal to 1.63 log (V/h) + log D-sub-L + log 0.0153. The latter relationship is more accurate and may be used for estimating reaeration coefficient of rivers with velocity not exceeding 1.2 meter/second and the depth less than 0.5 meters. (Wilde-Wisconsin)
W70-07258

CRYSTALLIZATION OF EUTROPHICATION CONCEPTS IN NORTHERN EUROPE,
Uppsala Univ. (Sweden). Inst. of Limnology.
Wilhelm Rodhe.
Eutrophication: Causes, Consequences, Correctives, p 50-64. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 3 fig, 49 ref.

Descriptors: *Eutrophication, *History, Phytoplankton, Oligotrophy, Primary productivity, Ecosystems, Peat, Bogs, Nutrients, Limnology, Oxygen, Distrophy, Hypolimnion, Wisconsin, Organic matter, Carbon radioisotopes, Aging (Biological), Soils, Climatic data, Shape, Oxidation-reduction potential, Phosphates, Mud, Iron, Sulfides, Indicators, Biological communities, Lakes, Classification.
Identifiers: Mixotrophy, Saprobionts, Saprobic, Saprobiensystem, Lake typology, Eutrophication concepts, Trophy, Autotrophy, Allotrophy.

History of ecological classification of lakes, lake typology, trophic classification concepts, and lake evolution are discussed. Naumann chose phytoplankton production where algal production and nutrient level appeared to disagree. Trophy indicates intensity and kind of organic matter supply; autotrophy indicates intensity of its own total organic matter production; allotrophy indicates intensity of organic supply from its environment. Autotrophy is based on the level of primary production of phytoplankton, sessile algae, and higher vegetation combined. Investigations showed that the rate of organic matter production in the photosynthetic layer determines oxygen consumption in the mud-water interfaces and consequent nutrient liberation from sediments. The German terms 'saprobionts' (Saprobien) and 'saprobic' are used for organisms living in water more or less polluted by putrescible organic matter. Shortcomings of Saprobiensystem are due to its dependence on deficient foundations of scientific principles and definitions. Saprobicity indicates total ecosystem respiration and can be measured, at least as to order of magnitude, by metabolic-dynamic methods. These assessments can be combined with qualitative and quantitative determinations of the organism communities. Biomass exchange of autotrophs and heterotrophs can indicate biocenoses structure and saprobicity level, thus establishing connection between trophic concepts and essential aspects of Saprobiensystem. (See also W70-03975). (Jones-Wisconsin)
W70-07267

EUTROPHICATION INDICES AND THEIR RELATION TO OTHER INDICES OF ECOSYSTEM CHANGE,
Michigan Univ., Ann Arbor.
Frank F. Hooper.
Eutrophication: Causes, Consequences, Correctives, p 225-235. Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. 27 ref.

Descriptors: *Eutrophication, Data collections, Evaluation, Forecasting, Morphometry, Productivity, Nutrients, Dissolved oxygen, Phosphorus, Photosynthesis, Ecosystems.
Identifiers: *Eutrophication indices, Species diversity, Transparency, Species stability.

There are four criteria of a useful eutrophication index: (1) it should discriminate between changes associated with nutrient level and those associated with other categories of environmental change; (2) it should have considerable sensitivity to levels of enrichment; (3) it should have properties which are widespread geographically and short-lived geologically; (4) it should be suitable for long-term surveillance and monitoring. Indices should both document past changes and serve a predictive function. Indices showing greatest promise at present are species diversity, carbon fixation and production-consumption balance. Specific biological indicators are rare; further research on such organisms is needed. Nutrient levels are useful but continuous monitoring is necessary; turnover rates of nutrients, especially phosphorus, may serve as stable indices. Morphometric indices, transparency data and oxygen budgets show less promise due to lack of ubiquity and low sensitivity. All indices used thus far measure processes occurring at all stages of enrichment; they are not specific for normal or cultural eutrophication. To gain specificity, such indices must measure changes over a considerable time span. Acceleration will appear as a change in intensity or rate of process; detection of such accelerations will make possible the differentiation of normal and cultural processes of eutrophication. (See also W70-03975). (Voigtlander-Wisconsin)
W70-07270

BATCH CULTURING OF THERMOPHILIC BENTHIC ALGAE AND PHOSPHORUS UPTAKE IN A LABORATORY STREAM MODEL,
Wisconsin Univ., Milwaukee. Dept. of Botany.
Jon A. Sperling, and Ralph Grunewald.
Limnology and Oceanography, Vol 14, p 944-949, 1969. 4 fig, 8 ref.

Descriptors: *Algae, *Cultures, *Phosphorus, Analytical techniques, Model studies, Streams, Currents (Water), Biomass, Laboratory tests, Thermal water.
Identifiers: *Thermophilic algae, *Phosphorus uptake, Batch cultures, Stream models, Scintillation detector, AEC Analyzer, Southwest Iceland, Hot Springs.

Stimulation in the biomass growth and the uptake of radiophosphates due to increased rate of water flow is described. The study was conducted in an 1- by 2-meter stream model with 2 Plexiglas channels. Mastigocladus laminosus, a thermophilic alga, served as the test organism. Apparatus and methods are described. (Wilde-Wisconsin)
W70-07284

INDUSTRIAL DESIGN STUDY FOR AN AIRBORNE IR MAPPER,
Utah Center for Water Resources Research, Logan.
Donn C. Goode.
Available from the Clearinghouse as PB-192 210, $3.00 in paper copy, $0.65 in microfiche. Utah State University Center for Water Resources Research Report CWRR-14-3, Masters Thesis in Industrial and Technical Education, 1969. 39 p, 14 fig, 1 tab, 7 ref. OWRR Project A-004-UTAH (5).

Descriptors: *Remote sensing, *Infrared radiation, *Mapping, *Instrumentation, Aircraft, Surveys, Terrain analysis, Research and development.
Identifiers: Airborne infrared mapping.

An industrial design and development study was made to create an inexpensive infrared aerial mapping instrument which can be adapted for basic research. The instrument was designed for installation on board a conventional twin engine aircraft and requires minimal modifications. Aerial infrared terrain photographs are produced which are useful in a number of scientific research applications. These photographs are developed using a polaroid film pack which allows in-flight data evaluation. In addition, fine grain film and video tape recording can be used to permit laboratory analysis of data. Mechanical design considerations, operational characteristics, and preliminary laboratory test data are described. (Knapp-USGS)
W70-07330

SPECTRAL INFRA-RED REFLECTION MEASUREMENTS FROM NATURAL AND TREATED ASPEN FORESTS,
Utah Center for Water Resources Research, Logan.
Frank W. Haws, Ralph Briscoe, and Allan Steed.
Available from the Clearinghouse as PB-192 209, $3.00 in paper copy, $0.65 in microfiche. Utah State University Center for Water Resources Research Report CWRR-14-4, December 1969. 17 p, 7 fig, 1 tab, 5 ref. OWRR Project A-004-UTAH (4).

Descriptors: *Remote sensing, *Infrared radiation, *Spectroscopy, *Transpiration control, *Evapotranspiration control, Chemcontrol, Soil moisture, Water yield improvement, Utah, Transpiration, Evapotranspiration, Water conservation, Vegetation effects, Consumptive use.
Identifiers: Aspen trees.

Spectral reflectance measurements were made during the summers of 1967 and 1968 on a natural stand of aspen in Utah, part of which was treated with foliar chemicals. The previous year spectral reflectance measurements were made on individual plants in the laboratory. The stand averages about 55 feet in height on a south-facing slope of about 25 percent and is located in the aspen zone of vegetation of the Wasatch Mountains at an elevation of about 7800 feet. The reflectance from the vegetation due to various environmental changes is highly wavelength dependent. The laboratory measurements showed a definite decrease in infrared reflectance as the soil moisture was depleted. The field measurements in the natural watershed showed a similar reduction in infrared reflectance after a considerable number of days without precipitation. In both the laboratory and the field measurements the infrared reflection loss occurred while the apparent visible reflection remained constant. (Knapp-USGS)
W70-07332

APPLICATION OF SHORT-LIVED COSMOGENIC RADIONUCLIDES AS TRACERS OF IN-CLOUD SCAVENGING PROCESSES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
For primary bibliographic entry see Field 02B.
W70-07337

MEASUREMENT OF THE VELOCITY OF GAS BUBBLES IN WATER BY A CORRELATION METHOD,
European Atomic Energy Community, Ispra (Italy). Reactor Physics Div.; and European Atomic Energy Community, Ispra (Italy). Heat Transfer Div.
W. Matthes, W. Riebold, and E. De Cooman.
The Review of Scientific Instruments, Vol 41, No 6, p 843-845, June 1970. 3 p, 5 fig, 1 tab, 2 ref.

Descriptors: *Flowmeters, *Bubbles, *Instrumentation, *Flow measurement, *Optical properties, Air entrainment, Aeration, Correlation analysis.
Identifiers: Multiphase flow, Lasers.

An experimental method is suggested for the measurement of the gas bubble velocity in water flow using a correlation method well known in neutron physics. Two laser light beams (L-1, L-2)cross the region of two phase flow and are registered by two photodiodes (F-1, F-2). A bubble crossing L-1 leads to an intensity variation of the light beam due to scattering and refraction and gives rise to an electric pulse in F-1. This pulse triggers a multichannel time analyzer. The pulses from F-2 (due to bubbles crossing L-2) are fed into the time channels and stored corresponding to their time delay relative to the trigger pulse. The change of the bubble velocity is greater in the case of liquid flow rate variation (entrainment effect). The extremely high reproducibility of the cross correlation curves measured is emphasized. (Knapp-USGS)
W70-07356

AUTOMATIC METHODS FOR DETERMINING NITRATE AND NITRITE IN WATER AND SOIL EXTRACTS,
Norsk Institutt for Vannforskning, Blindern; and Norges Landbrukshoegskole, Vollebekk.
For primary bibliographic entry see Field 05A.
W70-07358

REMOTE SENSING ANALYSIS OF WATER QUALITY,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y. Observation Sciences Dept.
For primary bibliographic entry see Field 05A.
W70-07362

BOREHOLE SEISMICS MULTIPLY DRILL DATA,
Acoustical Minerals Exploration, Inc.
B. B. Brenden, V. I. Neeley, and G. F. Garlick.
Engineering and Mining Journal, Vol 171, No 2, p 93-96, Feb 1970. 4 p, 5 fig.

Descriptors: *Boreholes, *Drill holes, Acoustic equipment, *Borehole geophysics, *Geologic investigations, Geologic control, Geophysics, Subsurface investigations, *Sonic waves, Sonar, Sound waves, *Seismic investigations, Orientation, Joints (Geology), Faults (Geology), Ultrasonics, Sounding, Detectors.
Identifiers: Diamond drilling, Geologic defects, *Echo ranging, Well logging, Geophysical prospecting, *Sonic probes, Seismic reflection.

An accoustical imaging and mapping system was developed specifically for diamond drill holes. The technique is an extrapolation and refinement of sonar and ultrasonic nondestructive testing. When coupled with computer analysis of reflected echoes, the system gives detailed information on fault and vein structure between holes. High-power transducers for generating sound waves and detecting reflected waves are mounted in a probe that can be used in AX and larger size diamond drill holes. The range and resolution for detecting reflecting anomalies depend on several factors; typical values are a range of 25 ft with a resolution of 1 ft, and with modifications, a range of 200 ft with a resolution of about 10 ft. Strike, dip, and vein thickness may be calculated by solving the conventional 3-point problem. Calculations can be simplified by a mechanical device (the geologists' computer) that gives a direct readout of dip and strike. (USBR)
W70-07439

SATELLITE PHOTOGRAPHY FOR SNOW SURVEILLANCE IN WESTERN MOUNTAINS,
Allied Research Associates, Inc., Concord, Mass.
James C. Barnes, and Clinton J. Bowley.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 34-40, 1969. 7 p, 8 fig, 8 ref. ESSA Contract E-196-68.

Descriptors: *Snow surveys, *Snow cover, *Remote sensing, *Satellites (Artificial), *Runoff forecasting, Water management (Applied), Snowpacks, Snowmelt, Snow management, Streamflow forecasting.
Identifiers: Snow cover surveys.

Satellite photography can already provide the hydrologist with useful information concerning snow cover distributions. From existing data, the horizontal distribution of snow can often be mapped as accurately as, or more accurately than, from a typical ground station network. Future mapping, based on higher resolution camera systems, can be expected to be considerably more accurate than from ground stations, especially in remote areas where the reporting network is sparse. With more sophisticated earth-viewing geophysical satellites planned for the coming years, the outlook for operational snow mapping from satellite data is promising. (See also W70-07535). (Knapp-USGS)
W70-07534

HYDROLOGY OF SNOW PROFILES OBTAINED WITH THE PROFILING SNOW GAGE,
Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 02C.
W70-07535

A 2-YEAR EVALUATION OF THE SNOWMELT LYSIMETER,
Forest Service, Moscow, Utah. Forestry Sciences Lab.
Harold F. Haupt.
Proceedings 37th Annual Meeting of Western Snow Conference, Apr 15-17, 1969, Salt Lake City, Utah; printed by Colorado State Univ, Fort Collins, p 97-101, 1969. 5 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Snowmelt, *Lysimeters, Streamflow forecasting, Runoff forecasting, Instrumentation, Water yield, Water supply, Hydrographs.
Identifiers: Snowmelt lysimeter.

A snowmelt lysimeter operation is described, and a history of other snowmelt lysimeters and their operations are reviewed. The lysimeter designed for this study has an area of only 2.72 square feet and appears more adaptable for research operations than earlier lysimeters. A detailed description is presented and illustrated by schematic drawings. The catchment area was sealed off by a polyethylene barrier that guided snowmelt water into a plastic pipe, thence into a 50 gallon barrel receiver with a Stevens Type A-35 stage recorder. Time rates of melting by 1/2; 1; 2; 6; and 24 hourly intervals were recorded for clear, and rain on snow occasions. This snowmelt lysimeter provided direct measurements of melt output during clear weather, as well as rain percolating through the pack plus melt during rainy periods. By following the installation and operation procedures outlined in the report, accurate data can be obtained at relatively low cost. (See also W70-07542). (Knapp-USGS)
W70-07541

7C. Evaluation, Processing and Publication

RECONNAISSANCE OF THE PIGEON RIVER, A COLD-WATER RIVER IN THE NORTHCENTRAL PART OF MICHIGAN'S SOUTHERN PENINSULA,
Geological Survey, Washington, D.C.
G. E. Hendrickson, and C. J. Doonan.
For sale by US Geological Survey, Dept of Interior, Wash, DC -- Price $1.25 per set. US Geological Survey Hydrologic Investigations Atlas HA-333, 2 sheets, 1970. Text, 11 fig, 4 tab, 3 map, 4 ref.

Descriptors: *Water resources, *Recreation, *Rivers, *Michigan, *Sport fishing, Camping, Boating, Streamflow, Water quality, Channel morphology.
Identifiers: Pigeon River (Mich).

The Pigeon River, one of Michigan's outstanding trout streams, the favorite of a large number of anglers who return year after year, is discussed in a 2-sheet hydrological atlas consisting of maps, charts, profiles, graphs, tabulated data, and text. Camping is also popular and is usually, but not always, associated with fishing. Boating is very rare on the Pigeon because of numerous portages around log jams. The Pigeon is located in the north-central part of the southern peninsula of Michigan. Headwaters are a few miles northeast of Gaylord, and the mouth is at Mullet Lake, a few miles northeast of Indian River. Interstate Highway 75 roughly parallels the river about 5 to 10 miles to the west. Exits from this highway at Gaylord, Vanderbilt, Wolverine, and Indian River, provide easy access to the Pigeon. The recreational value of the river depends on the streamflow characteristics, quality of water, and character of stream channel, and bed and banks. The purpose of this atlas is to describe these characteristics, and to show how they relate to recreational uses. Sheet 1 of this atlas presents information on streamflow characteristics and water quality. Sheet 2 describes the physical characteristics of the stream channel, and bed and banks, and shows how these physical characteristics relate to streamflow, water quality, and recreational use. (Knapp-USGS)
W70-07166

DEVELOPMENT OF A FLOOD-FORECASTING SYSTEM FOR THE LATROBE RIVER AT YALLOURN,
Bureau of Meteorology, Melbourne (Australia).
For primary bibliographic entry see Field 02E.
W70-07177

DIGITAL SIMULATION METHODS FOR HYDROLOGICAL FORECASTING,
Stanford Univ., Calif.
For primary bibliographic entry see Field 02E.
W70-07181

THE METHOD OF INFLUENCE-FUNCTION DETERMINATION FOR LINEAR RUN-OFF MODELS,
For primary bibliographic entry see Field 02E.
W70-07187

METEOROLOGICAL TABLES FOR DETERMINATION OF PRECIPITABLE WATER, TEMPERATURES, PRESSURES ALOFT FOR A SATURATED PSEUDOADIABATIC ATMOSPHERE - IN THE METRIC SYSTEM,
Texas A and M Univ., College Station. Water Resources Inst.
W. O. Eille, R. J. Powers, and Robert A. Clark.
Available from the Clearinghouse as PB-192 089, $3.00 in paper copy, $0.65 in microfiche. Texas Water Resources Institute Technical Report No 16, Dec. 1968. 30 p, 3 tab, 2 ref. OWRR Project A-002-TEX (8).

Descriptors: *Precipitable water, *Data collections, *Meteorological data, *Precipitation (Atmospheric), Rain, Gases, Water vapor, Clouds, Condensation, Rainfall disposition, Water sources, Water yield.

Tables have been prepared in the Metric system for the determination of precipitable water in a saturated atmosphere with a pseudoadiabatic lapse rate. In addition, tables were prepared from which temperature and pressure also can be determined. These tables have rather wide application in hydrometeorological work.
W70-07228

TECHNIQUES FOR EVALUATING LONG-TERM RESERVOIR YIELDS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 06A.
W70-07234

THE RESPONSE OF THE NORTHEASTERN NEW JERSEY WATER TRANSFER NETWORK TO THE 1962-1966 DROUGHT,
Rutgers - The State Univ., New Brunswick, N. J. Dept. of Geography.
For primary bibliographic entry see Field 06E.
W70-07286

EVALUATION OF NATURAL RIVERS,
Antioch Coll., Yellow Springs, Ohio.
For primary bibliographic entry see Field 06B.
W70-07327

DATA FOR WELLS IN THE DOS PALOS-KETTLEMAN CITY AREA, SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
R. A. LeBlanc.
U S Geological Survey Open-file report, January 21, 1970. 128 p, 2 fig, 56 map, 2 tab, 1 ref.

Descriptors: *Water wells, *California, Depth, Screens, Data collections, Castings, Hydrologic data, Surveys, Aquifers.
Identifiers: San Joaquin Valley (Calif).

The Dos Palos-Kettleman City area is in the west and central part of the San Joaquin Valley, in western Fresno and western Kings Counties, California. Between December 1967 and July 1968, 2,690 wells previously canvassed were field checked for use and horsepower changes, and an additional 1,035 wells were canvassed. Selected data, for water wells with a minimum of depth or chemical information, are tabulated and the locations of these wells are shown on maps. A tabulation of all preempted well numbers assigned by the Geological Survey and cooperating agencies through July 1968 is included. (LeBlanc-USGS)
W70-07360

WATER RESOURCES OF SOUTHERN MARYLAND,
Geological Survey, Washington, D.C.
James M. Weigle, Wayne E. Webb, and Richard A. Gardner.
Available for sale by U S Geological Survey, Dept. of Interior, Washington, D.C. 20242 - $1.75 per set. U.S. Geological Survey Hydrologic Investigations Atlas HA-365, 3 sheets, 1970. Text, 6 fig, 13 map, 4 map, 30 ref.

Descriptors: *Water resources, *Surface-groundwater relationships, *Maryland, Groundwater, Surface waters, Water supply, Water yield, Water quality, Hydrogeology, Hydrologic data, Data collections, Aquifers, Streamflow, Water wells, Low flow, Floods, Runoff, Rainfall-runoff relationships.
Identifiers: *Southern Maryland, Potomac River Basin.

A 3-sheet hydrological atlas consisting of text, small-scale maps, graphs, charts, and tabulated data summarizes the results of a water-resources investigation conducted in southern Maryland during 1966 and 1967. Southern Maryland as used in this report includes Calvert, Charles, and St. Marys Counties. Paritcular consideration is given to the relationship of groundwater to surface water, changes in groundwater conditions in recent years, yields potentially obtainable from wells, sustained yields, streamflow yield, chemical quality of the water, and the likelihood of groundwater contamination by salt water from Chesapeake Bay or estuaries. (Knapp-USGS)
W70-07367

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF THE MISSOURI RIVER ALLUVIUM BETWEEN JEFFERSON CITY AND MIAMI, MISSOURI,
Geological Survey, Washington, D.C.
L. F. Emmett, and H. G. Jeffery.
Report available for sale from U S Geological Survey, Dept. of Interior, Washington, D.C. - Price 50 cents. U S Geological Survey Hydrologic Investigations Atlas HA-340, 1 sheet, 1969. Text, 6 fig, 1 tab, 1 map, 14 ref.

Descriptors: *Water resources, *Surveys, *Aquifers, *Alluvium, *Missouri River, Groundwater basins, Petrography, Water quality, Water chemistry, Water yield, Water sources, Water wells, Geology, Hydrogelolgy, Hydrolgogic data, Groundwater.
Identifiers: *Alluvial deposits, Jefferson City (Mo), Miami (Mo).

This hydrologic atlas describes the thickness, areal extent, and lithology of the alluvial deposits of the Missouri River between Jefferson City and Miami, Missouri, and provides information on the occurrence, availability, use, and chemical quality of the water contained in the alluvial aquifer. Flood-plain widths vary from 1.8 to 6.4 miles and have a total surface area of approximately 285 square miles. The flood plain is underlain by alluvium consisting of clay, silt, sand, and gravel which has been deposited by the river. The sand and gravel in the lower part of the alluvium is saturated with water and forms the alluvial aquifer. The water in this aquifer is in hydraulic connection with the Missouri River. Graphs, tables, illustrations and a hydrologic map (scale 1:125, 000) are included in the Atlas. (Woodard - USGS)
W70-07368

SNOWMELT SIMULATION,
Utah Water Research Lab., Logan; and Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02C.
W70-07536

08. ENGINEERING WORKS

8A. Structures

ASPHALT DIAPHRAGMS FOR DAMS BUILT OF LOCAL MATERIALS.
For primary bibliographic entry see Field 08G.
W70-07422

CALIFORNIA UNDERSEA AQUEDUCT PRERECONNAISSANCE STUDY.
Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Sacramento, Calif.

Bur Reclam Report, Dec 1969. 107 p, 3 fig, 501 ref, append.

Descriptors: Aqueducts, *Preliminary investigations, Water resources development, *Water conveyance, *Water requirements, Ecology, *Water transfer, Marine geology, Costs, Bathymetry, Hydrodynamics, *Pipelines, Aquatic environment, Aquatic life, Construction materials, *Underwater construction, Bibliographies, Oceans, California.
Identifiers: Marine biology, *Offshore structures, *Undersea aqueduct (Collective), *Submarine pipelines, Reconnaissance studies.

The study includes 4 major elements: (1) a preliminary evaluation of potential requirements for import water in Southern California and of potential supplies available for export from Northwestern California; (2) an analysis of the state of knowledge regarding materials and accessories for an undersea aqueduct, the marine environment, construction and maintenance problems, and available information on tides, waves, and currents; (3) determination of what additional research and testing would be required to provide data for a full-scale reconnaissance investigation; and (4) development of a program for such an investigation. A full-scale reconnaissance investigation of the California Undersea Aqueduct would cost about $2,188,000 and would take about 5-1/2 yr. The program would be divided into 2 phases. Phase 1, Basic Research, would require 2 yr for a reliable assessment. Phase 2, Reconnaissance Studies, would extend an additional 3-1/2 yr. Based on rough cost estimates prepared by National Science Engineering Co, and modified by the Bureau of Reclamation, cost of water delivered through an undersea aqueduct could possibly be competitive with the cost of water delivered from other potential sources. Has 501 references. (USBR)
W70-07423

WELL SCREENS AND GRAVEL PACKS,
Water Research Association, Medmenham (England).
A. Hunter Blair.
Groundwater, Vol 8, No 1, p 10-21, Jan-Feb 1970. 12 p, 3 fig, 1 tab, 19 ref.

Descriptors: *Water wells, *Wells, *Well screens, Aquifers, Head loss, Unconsolidated soils, Gravels, Sands, Slots, Installation, Maintenance, Sieve analysis, Particle size, Bibliographies, Groundwater, Fines.
Identifiers: *Gravel packs, Slotted walls, Corrosion resistance, Clogging.

The purpose of well screens and gravel packs is to maintain open access within the aquifer, ensuring that thorough development of the well is not impeded by sand. When a well draws on unconsolidated sands and gravels or friable materials, a screen and pack are essential. Well screen designs should incorporate the following features: (1) minimum entrance velocity, (2) maximum open area of screen, (3) correct design of slots to minimize blockages, (4) slot size that matches aquifer or gravel pack medium, (5) corrosion-resistant screen material, and (6) provision for periodic maintenance. A slot shape offering the maximum open area consistent with strength is a priority. Blockage of screens may be caused by chemical deposition formed by precipitation or corrosion products, and coated screens have been used to inhibit this. Gravel packs should include the following design features: (1) sandfree operation after development, (2) lowest possible resistance to permeation, (3) low entrance velocities, (4) resistance to chemical attack, and (5) efficient service life. Gravel pack design should be guided by standard sieve analysis. (USBR)
W70-07437

SMALL DIAMETER WELLS DRILLED BY JET-PERCUSSION METHOD,
Arizona Univ., Tucson.
W. G. Matlock.
Ground Water, Vol 8, No 1, p 6-9, Jan-Feb 1970. 4 p, 4 fig, 3 ref.

Descriptors: *Water wells, *Wells, *Drilling, *Observation wells, *Jets, Drill holes, Neutron counters, Drilling equipment, Well casings, Alluvium, Arizona.
Identifiers: *Jetting, *Percussion drilling, Probes (Instruments), Neutron moisture probes.

Observation wells and access holes for neutron probe use were drilled by a jet-percussion drill rig in coarse alluvial material near Tucson, Ariz. The method combines jetting action that removes loose materials effectively with the percussion necessary to break up tighter formations and large particles. A unique feature of the equipment is the provision for simultaneously drilling and driving the casing to keep the hole open in loose formations. Washed samples of the material being drilled can be obtained from the recirculating water system. Drilling rates were from 7 to 10 ft per hour, and costs including casing were less than $1.50 per ft. Maximum depth is about 100 ft. The drilling rig and drilling method are described. (USBR)

W70-07438

A METHOD FOR ESTIMATING THE ULTIMATE LOAD CAPACITY OF ARCH DAMS,
Indian Inst. of Science, Bangalore.
K. V. Swaminathan and A. Rajaraman.
Water Power, Vol 22, No 2, p 54-62, Feb 1970. 9 p, 13 fig, 27 ref.

Descriptors: Estimating, *Ultimate loads, *Arch dams, Hinges, Concrete dams, Dams, Dam design, Dam failure, *Structural behavior, Thrust, Loads (Forces), Compressive strength, Structural analysis, Deformation, Stress distribution, Foreign design practices, Cantilevers, Load distribution, Bibliographies, Design tools, Moments, Moment distribution.
Identifiers: *Ultimate strength, Arch action, Plastic hinges, Crushing stength, Compressive stress, Thrust loads, Tolke method, India.

Experimental and theoretical analyses are cited, showing that shell and arch concrete structures may develop hings lines along sections about which adjacent parts rotate under increasing load. A method based on the development of hinge lines for estimating the ultimate load capacity of arch dams is described. The behavior of arch dams loaded by a gradually increasing pressure is divided into 3 stages; a theoretical analysis using a modified form of Tolke's method for the different stages is given. The simple method can be used to estimate the ultimate load capacity of arch dams when the shape of the dam and valley can be idealized. Results obtained using the method agree fairly closely with model test results. (USBR)
W70-07440

THE BACKWATER RESERVOIR WORKS OF THE EAST OF SCOTLAND WATER BOARD.

Water and Water Engineering, Vol 73, No 885, p 449-457, Nov 1969. 9 p, 13 fig.

Descriptors: Water resources, *Earth dams, *Grout curtains, *Grouting, Cutoff walls, Overburden, *Reservoirs, Water storage, Rivers, Reservoir storage, Industrial water, *Faults (Geology), Fissures, Sedimentation, Joints (Geology), Bedrock, Bentonite, Silicates, Spillways, Weir crests, Chemical grouting, Foreign construction, Foreign projects.
Identifiers: *Grout coverage, Great Britain, Scotland.

Backwater Reservoir has a capacity of 5500 million gallons of water and adds 9 million gallons per day to the resources of the East of Scotland Water Board. The reservoir is the first stage of developments planned to add successively further quantities of 6, 12, and 15 million gallons per day to the Board's resources. Backwater Dam is the first major earth dam to be constructed in the United Kingdom where a grouted cutoff curtain through overburden has been constructed. A pattern of holes extended into bedrock was drilled across the valley on the centerline of the dam. Three types of grout were used: silicate, clay cement, and deflocculated bentonite. 550,000 cu ft of grout were injected into the ground. The technique employed could make possible the development of water storage in valleys previously dismissed from serious consideration because of unfavorable or uncertain ground conditions. (USBR)
W70-07442

CHANGES IN NATURAL CHANNELS DOWNSTREAM FROM MAN-MADE RESERVOIRS,
Mississippi State Univ., State College. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-07519

8B. Hydraulics

THE FULLY-MIXED STREAM TEMPERATURE REGIME,
Tennessee Valley Authority, Norris.
For primary bibliographic entry see Field 02E.
W70-07324

FORMATION OF HYDRAULIC JUMPS IN A ROTATING SYSTEM,
Naval Postgraduate School, Monterey, Calif., and Utah Univ., Salt Lake City.
R. T. Williams, and A. M. Hori.
Journal of Geophysical Research, Vol 75, No 15, p 2813-2821, May 20, 1970. 9 p, 9 fig, 13 ref. NSF Grant GA-849.

Descriptors: *Hydraulic jump, *Mathematical studies, *Hydraulics, *Rotational flow, *Hydrodynamics, Froude number, Surges, Turbulent flow.
Identifiers: Rossby number, Rotating fluid systems.

The formation of hydraulic jumps in a rotating, homogeneous, one-layer fluid is investigated. A scale analysis indicates that jump-formation cases should be separated from nonjump cases by a curve in which the Froude number is proportional to the square of the Rossby number. Numerical solutions verify the curve up to $F = 0.33$ and show that the coefficient of proportionality is in the range 6.0-7.5. The solutions for $F = 1.0$ are examined in considerable detail. Jumps can occur in the nonjump region when large evolution times are allowed. This relation has several possible applications in meteorology and oceanography. Internal waves in the ocean are affected by rotation, and the breaking of these waves should be described by the model. Hydraulic jumps may also be important in storm surge prediction. (Knapp-USGS)
W70-07354

POWER INTAKES,
International Power and Engineering Consultants Ltd., Vancouver (British Columbis).
R. E. Johnson, and P. E. Fawkes.
Engineering Journal (Canada), Vol 52, No 10, p. 61-65, Oct 1969. 5 p, 6 fig, 2 ref.

Descriptors: Intake gates, Intakes, *Intake structures, Intake towers, Hydroelectric plants, Powerplants, *Hydraulic models, *Hydraulic design, Hydraulic structures, Model studies, *Model tests, Surges , Mathematical models, Foreign design practices.
Identifiers: Peace River Proj (Canada), Intake channels, *Approach channels, Portage Mountain Powerplant (Canada), Canada.

Hydraulic scale models and a mathematical model used in designing the power intake structures for Portage Mountain Powerplant, located on the Peace River in Canada, are discussed. The structures consist of 10 individual intakes that have free standing gate towers located at the upstream toe of the dam. Seven towers were designed to operate over a 100-ft range of reservoir level and 3 towers were set 110 ft lower to permit early power generation during initial reservoir filling. A 1:70 scale model covering the area upstream from the intakes was used to study the approach channels and the performance of the intakes over the range of operating reservoir levels. A 1:32.2 scale model of a single low-level intake was used to study the hydraulic behavior of the intakes. Surge in the gate shafts was analyzed by using a mathematical model. The model studies resulted in better flow distribution to thelow-level intakes, substantial reductions in excavation in the approach channels, and several improvements in the design of the intake structures. (USBR)
W70-07427

MANIFOLD AND TAILRACE SYSTEM,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
P. W. W. Bell.
Engineering Journal (Canada), Vol 52, No 10, p. 66-70, Oct 1969. 5 p, 7 fig, 1 ref.

Descriptors: *Tailrace, Hydraulics, Hydraulic models, Tunnels, Surges, Hydroelectric plants, Hydroelectric power, Foreign design practices, Foreign construction, Open channel flow, *Hydraulic design, Hydraulic transients, Head loss, *Model studies, Cavitation, Water hammer, Model tests, Optimum design.
Identifiers: Portage Mountain Powerplant (Canada), Canada, *Manifolds, Surge waves, Friction coefficient (Hyd), Analytical method.

The tailrace of the 2270-mw Gordon M Shrum Powerplant in Canada is designed as a free-surface system consisting of 2 rectangular collection manifolds, each discharging through a modified horseshoe tunnel to a transition section where the 2 flows join to feed a common tailrace channel. The analytical and model studies used in optimizing the design of major components of the sytem are discussed. Operating experience with Tunnel No. 1 has confirmed the results of these studies. Several schemes are reviewed for maintaining tailrace manifold water levels above a predetermined elevation during the period between initial operation and that of future construction downstream of the tailrace. This tailwater elevation must be held during the interim period to prevent turbine cavitation and water column separation in the draft tube. (USBR)
W70-07428

BOUNDARY SHEAR STRESS DISTRIBUTION IN RECTANGULAR OPEN CHANNELS,
Calgary Univ. (Alberta).
N. Rajaratnam and D. Muralidhar.
La Houille Blanche, No 6, p 603-609, 1969. 7 p, 13 fig, 1 tab, 18 ref.

Descriptors: Open channels, *Open channel flow, Laboratory tests, Wall friction, *Stress distribution, *Boundary shear, Boundary layers, Froude number, Water surface profiles, *Supercritical flow, Hydraulics, Flumes, Hydraulic models, Bibliographies, Velocity distribution, Turbulent flow, Reynolds number, Foreign research, Skin friction.
Identifiers: *Rectangular channels, Bed shear, Aspect ratio, Canada.

Hydraulic laboratory experiments were conducted to determine measurements of the shear stress distribution at supercritical velocity in smooth rectangular channels. Maximum stresses on the bed and sides were correlated with the results of the boundary layer theory. A relation was obtained connecting the maximum wall shear stress with the bed shear stress in an infinitely wide channel, and the boundary layers on the bed and sides were studied regarding the velocity distribution. Some interesting results were obtained regarding the velocity dip at the free surface and the discharge distribution. The Froude number of the flows varied from about 1.1 to about 2.4. In the entire range of Froude numbers studied, no perceptible formation of roll waves occurred. (USBR)
W70-07441

8C. Hydraulic Machinery

NO-ELECTRODE MHD HAS AC OUTPUT.

Electrical World, Vol. 173, No. 21, May 25, 1970. p 23, 1 fig.

Descriptors: *Alternating current, *Electrode, Powerplants, Electric power production.
Identifiers: *Whittaker design, *Magnetohydrodynamic Power generation, Runaway electron, Plasma seeding, Ring current.

Physicists have devised a new method of magnetohydrodynamic power generation. The new system, called the Whittaker design, differs greatly from the old MHD generating system. This new technique involves the pumping of a fuel-air mixture into the combustion chamber at atmospheric pressure where it is ignited to produce a gas at high temperature and pressure. The gas explodes through a nozzle into the low-pressure generator channel, resulting in a 'runaway electron' condition in which conductivity of the plasma is unusually high. The high-velocity plasma interacts with a magnetic field within the generator to produce a strong ring current. By rising and falling with each explosion, the generated current can be connected to an external load through transformer wirings. Special advantages are that there is no need for electrodes in the extraction of electrical energy and that high-voltage current is produced, thus eliminating dc-to-ac power inversion. (Green-Vanderbilt)
W70-07319

ELECTRICAL FEATURES OF THE PRTAGE MOUNTAIN DEVELOPMENT,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
R. D. Handel, F. Langenek, and E. D. Mackie.
Engineering Jornal (Canada), Vol 52, No. 10, p. 88-98, Oct 1969. 11 p, 10 fig, 6 ref.

Descriptors: *Hydroelectric plants, Underground powerplants, Control, *Switchyards (Electrical), Bus (Electrical), Foreign construction, Fire alarm systems, *Electric generators, *Power transformers, Methane, Fire safety, Supervisory control (Power), Governors, Data collection systems, Excitation, Recording systems.
Identifiers: *Control equipment, *Protection (Electrical), Portage Mountain Powerplant (Canada), Canada, Peace River Proj. (Canada).

The Portage Mountain Development has an ultimate installed capacity of 2270 mw generated by 10 underground units. The station layout and major electrical equipment are described. A 500-kv switchyard supplies two 500-kv transmission lines to the Vancouver area, and a 138-kv switchyard supplies local load centers. The 138-kv switchyard contains breaking resistors applied during system disturbances to control accelerating power levels. The station features forced-cooled isolated phase buses connecting the underground powerhouse and the surface switchyard and rigid aluminum tubular buswork in the 500- and 138-kv switchyards. Details of station control methods are presented. The control and metering systems are largely selective, giving a compact central control facility. The operator is assisted by a digital data logger system, a solid-state event recorder, and automatic fault recorders. The generators employ electrohydraulic governing and static excitation. Joint VAR/VOLT control of the exciters and joint WATT control of the governors are supplied. The 500-kv transmission lines are protected by duplicate static distance relays using microwave and powerline carrier channels. (USBR)
W70-07429

HEATING AND VENTILATING OF UNDERGROUND AREAS,
International Power and Engineering Consultants Ltd., Vancouver (British Columbia).
N. Purssell, and M. N. Bakshi.
Engineering Journal (Canada), Vol 52, No 10, p 109-116, Oct 1969. 8 p, 3 fig, 12 ref.

Descriptors: *Heating, *Ventilation, *Cooling, design, Hazards, Shafts (Excavations), Air conditioning, *Underground powerplants, Construction, Tunnels, Foreign construction, Methane, Explosions, Powerhouses, Cold regions, Hydroelectric plants.
Identifiers: *Portage Mountain Powerplant (Canada), Peace River Proj (Canada), Canada.

The powerplant at Portage Mountain Development, Canada, located 500 ft underground, contains 3 million cu ft of space and 3 mi of tunnels. The article describes overall heating and ventilating design considerations, including methods for dilution and removal of methane gas and heating and ventilating during construction. Construction ventilation is normally the responsibility of the construction contractor, but for reasons of scheduling and because of the explosive gas hazard, a basic ventilating system was designed and partially installed before awarding the powerhouse construction contract. After construction of the generator hall, tunnels, and shafts, heating and ventilating was a problem because of the year-round rock temperature of about 40 deg F; after complete installation of generating units, cooling will be the problem. (USBR)
W70-07430

BUREAU OF RECLAMATION PUMPED STORAGE PLANTS,
Bureau of Reclamation, Denver, Colo.
Carlos G. Bates.
Paper at Amer Soc Civ Eng Nat Meet Water Resour Eng, Memphis, Tenn, Jan 1970. 24 p, 6 fig, 2 tab, append.

Descriptors: *Pumped storage, *Pump turbines, Hydraulic turbines, Hydroelectric power, *Electric power production, Maintenance, Pumps, Design, *Models, Valves, Peak power, Peaking capacities, Operations, Irrigation.
Identifiers: *Wicket gates, San Luis Pumping-Generating, O'Neill Pumping Plant, Calif, Bureau of Reclamation, Flatiron Powerplant, Colo.

The primary purpose of pump-turbine units is 2-way water handling to facilitate meeting irrigation water demands. The power produced is a bonus to the systems. The Bureau of Reclamation has 21 reversible pump-turbine units operating in 4 plants. Four additional units to be installed in 2 plants are in the design stage. The 4 operating pumped storage plants and the 2 plants being designed are discussed. When power system emergencies occur, rapid reversal from pumping to generating within a few seconds is an asset to the system. Pump-turbine design, operation, and maintenance considerations are given. Use of wicket gates or discharge valves depends on the needs of individual plant and power systems. Bureau startup problems have been minimal. Experience shows that majoration between model and prototype can be greater than the manufacturer anticipates. (USBR)
W70-07432

NEW LAW FOR LIQUIDS: DON'T SNAP, STRETCH,
National Engineering Lab., East Kilbride (Scotland).
Alan T. J. Hayward.
New Scientist, Vol 45, No 686, p 196-199, Jan 1970. 4 p, 5 fig.

Descriptors: *Cavitation, Trees, *Nucleation, Atmospheric pressure, Foreign research, Cohesion, Tensile strength, Tension, *Negative pressure, Bubbles, *Water properties, *Pumps, Hydraulic machinery, Fluid mechanics, Hydraulics, Liquids.
Identifiers: Cavitation control, Cavitation parameters, Cohesive strength, Great Britain, *Tensile properties, *Suction.

Trees can raise water to heights of 100 ft and more, but mechanical pumps can lift water no higher than 34 ft--the height the atmosphere will support a column of water. Nature utilizes the tensile strength of liquids to draw water to great heights. Water has a relatively high tensile strength capable of withstanding a tension of -300 atm. Pumps fail to lift water higher because of cavitation. Cavitation bubbles form under negative pressures from undissolved gas nuclei, from the breakup of other bubbles, and from cavities nucleated between rubbing surfaces. Undissolved gas nuclei normally are present in natural and distilled water, and are stable at atmospheric pressure for indefinite periods; however, water can be denucleated by applying high pressure and forcing the gas nuclei into solution. If man is to follow nature's example and design hydraulic machinery to operate under negative pressures without cavitation, the water must be denucleated and the cavitation-producing conditions avoided. By meeting these requirements, a suction pump was built that can lift water to a height of 56 ft under a negative pressure of -1 atm. (USBR)
W70-07434

THE ESCLANGON DIAGRAM FOR VOLTAGE AND CURRENT ALONG A TRANSMISSION LINE,
Institut Polytechnique, Grenoble (France).
Michel Poloujadoff.
Inst. Elec. Electron Eng. Spectrum, Vol 7, No 2, p 92-94, Feb 1970. 3 p, 6 fig, 6 ref.

Descriptors: *Transmission lines, *Graphical analysis, *Operations, Transmission (Electrical), Losses, Electric potential, Electric currents, Electrical impedance, Wavelengths, Foreign research.
Identifiers: Esclangon diagram, Transmission losses, France.

Graphic representations of abstract ideas and concepts are not discovered often. The Esclangon diagram, showing the variation of current and voltage along a transmission line for a steady sinusoidal operation, is given. Although the diagram does not replace other methods for solving transmission line problems, it is an efficient way of showing such variations, and provides a graphic technique that enhances considerably the art of transmission line operation. The method complements the Smith chart and the usage of basic formulas for a proper understanding of transmission line problems. (USBR)
W70-07443

8E. Rock Mechanics and Geology

DETERMINATION OF IN SITU STRESSES FOR THE UNDERGROUND PUMPING CHAMBER OF SOUTHERN NEVADA PUMPING PLANT NO 1,
Bureau of Reclamation, Denver, Colo.
G. L. Butler.
Bur Reclam Report REC-OCE-70-4, Jan 1970. 20 p, 16 fig, 8 tab.

Descriptors: Pumping plants, *Stress relieving, Stress analysis, Core drilling, Field tests, Structural behavior, *Underground structures, Stress distribution, Rock foundations, Boreholes, Drill holes, Strain measurement, *Rock mechanics.
Identifiers: Southern Nevada Pumping Plant No 1, In situ tests, *Borehole deformation gage, *Overcoring method.

The borehole stress relief method was used to determine the in situ stress in the rock mass surrounding the underground pumping chamber for Southern Nevada Pumping Plant No 1. A 3-directional borehole gage was used to measure the deformation of 1-1/2-in.-dia boreholes overcored with 6-in. drill bits to relieve stress. Three 25-ft boreholes having different orientation were drilled so that a 3-dimensional stress field could be computed. The stress field was determined at one location within the pumping chamber after excavation was completed, to check estimated values used in designing the chamber with available geological data. (USBR)
W70-07433

8F. Concrete

THE BACKWATER RESERVOIR WORKS OF THE EAST OF SCOTLAND WATER BOARD.
For primary bibliographic entry see Field 08A.
W70-07442

8G. Materials

ASPHALT DIAPHRAGMS FOR DAMS BUILT OF LOCAL MATERIALS.

Transl from Gidrotekh Stroit, No 11, p. 15-18, 1969. Bur Reclam Transl 835, Mar 1970, 11 p, 4 fig, 1 tab, 22 ref.

Descriptors: *Asphaltic concrete, Asphalt, *Diaphragms, Dams, Foreign design practices, Dam construction, Dam design, *Earth dams, Impervious membranes, Cold weather construction, *Rockfill dams, Bibliographies, Reliability, Maintenance, Cold regions.
Identifiers: Impervious layers, USSR, Electric heating, Asphaltic bitumens, *Poured asphalt, Asphalt membranes.

The expansion of hydrotechnical construction into regions of rigorous climate necessitates developing new means of leakage prevention in dams built with local materials. A method of constructing an internal vertical diaphragm of asphaltic concrete for the water barrier in earth or rockfill dams is described. The method includes using poured asphaltic concrete for the main body of the impervious layer, placed without compaction directly in a casing. To assure impermeability, a vertical interlayer of asphalt slurry can be constructed along the axis of the diaphragm by pouring hot asphaltic slurry into a vertical movable form. Electric heating of the slurry layer may be necessary in a particularly cold climate. Heating is necessary only for repair purposes following the appearance of leakage through the diaphragm. The interlayer of asphalt slurry and heating are not necessary in milder climates. Construction of such diaphragms is fairly simple and is independent of climatical conditions. Several examples of dams having diaphragm water barriers are cited, and some advantages and disadvantages of different types of diaphragms are discussed. Has 22 references. (USBR)
W70-07422

THE BACKWATER RESERVOIR WORKS OF THE EAST OF SCOTLAND WATER BOARD.
For primary bibliographic entry see Field 08A.
W70-07442

8H. Rapid Excavation

DIFFUSION BLASTING AND ITS POTENTIAL FOR THE DEVELOPMENT OF AUSTRALIA'S INLAND SURFACE WATER RESOURCES,
T. D. J. Leech.
Journal of the Institution of Engineers (Australia), Vol 41, No 10-11, p 165-173, Oct-Nov 1969. 9 p, 12 fig, 46 ref, 1 tab, 2 append.

Descriptors: Blasts, *Explosives, *Nuclear explosions, *Craters, Water loss, *Cratering, *Water storage, Water resources development, Radiation hazards, Thermal radiation, Costs, Cost comparisons, Seismic waves, Foreign research, Underground water storage, Bibliographies, Water resources, Underground explosions, *Reservoir construction, *Reservoirs.
Identifiers: Blasting, *Explosive construction, *Explosive excavation, *Nuclear excavation, Nuclear effects, Rapid excavation, Australia.

In Australia, little more than 2% of the total average discharge of rivers is being used effectively, but there are proposals to double the quantity of water stored during the next 2 decades. Then the availability of sites suitable for economic development of convetional storages will become limited. Use of chemical and nuclear explosives to blast craters for water storage is suggested. Principles of diffusion blasting and their applications to water resource development are reviewed. Cratering, use of multiple charges, and effects of air blast, thermal radiation, seismic waves, and radioactivity are discussed. Diffusion blasting is an attractive approach to water storage because unit costs are low, evaporation rates from craters are negligible, and seepage rates in many media are lowered by blasting. Layouts of a storage system consisting of multiple craters and a system consisting of a single crater are presented. A cost breakdown is given for a basic single crater system produced by a single one-megaton explosion that would result in a storage capacity of about 60,000 acre-ft. Gross capital cost for the system would be about $40 per acre-ft. A comparison of unit costs between conventional and crater storage is given.
W70-07431

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WATER-RESOURCES MANPOWER--SUPPLY AND DEMAND PATTERNS TO 1980.
Louisiana Water Resources Research Inst., Baton Rouge.
James E. Lewis.
Available from the Clearinghouse as PB-192 090, $3.00 in paper copy, $0.65 in microfiche. Louisiana Water Resources Research Institute Bulletin 4, May 19, 1970. 48 p, 5 fig, 21 tab, 26 ref. OWRR Project A-015-LA (2).

Descriptors: *Manpower, *Professional personnel, *Scientific personnel, Occupations, Human resources, Labor supply, Labor mobility, Specialization, Training.

This study focuses on the question: Can the United States satisfy the demand for water-resources manpower in the coming decade. The supply of scientific manpower supply and demand are disaggregated to yield supply and demand projections for water-resources manpower. This supply-engineers, natural scientists, and social scientists--is projected at 3.3 million for 1980; the demand, at 3.5 million. Supply and demand relationships for 1970-1980 decade show a 10-percent deficit of engineers, a 5-percent surplus of natural scientists, and a 7 to 8 percent deficit of social scientists. The supply of water-resources manpower is projected to reach 154,000 by 1980, with about 55,000 persons engaged in research. The 1980 demand for workers in the same field is projected at 267,000, with 95,000 needed in research. Critical manpower shortages are forecast in several disciplines: ecology, hydrology, water-resources planning and management, water quality, and watershed management.
W70-07229

9D. Grants, Contracts, and Research Act Allotments

RESEARCH DEVELOPMENT AND DEMONSTRATION PROJECTS, Division of Applied Science and Technology.
Federal Water Quality Administration, Washington, D.C.
For primary bibliographic entry see Field 5G.
W70-07230

10. SCIENTIFIC AND TECHNICAL INFORMATION

A BIBLIOGRAPHY OF BOOKS ON THE ENVIRONMENT -- AIR, WATER AND SOLID WASTES,
Toledo Univ., Ohio. Dept. of Chemical Engineering.
Gary F. Bennett, and James W. Hostman.
Toledo University Research Foundation Report, June 1969. 52 p, 564 ref.
Descriptors: *Bibliographies, *Environmental sanitation, *Pollution abatement, Environment, Environmental engineering, Waste treatment, Water pollution control, Air pollution, Water quality, Water chemistry, Water treatment, Biochemistry, Hydrology, Water resources, Waste disposal.

This bibliography of 564 references on environmental pollution and sanitation lists technical and nontechnical books as well as journals and conference proceedings. The topics listed include waste water treatment, water chemistry and treatment, biochemical engineering, microbiology, hydrology, water resources, air pollution, solid waste, and related subjects. (Knapp-USGS)
W70-07190

AQUATIC BIOLOGY ABSTRACTS, 1969.
CCM Information Corporation, 909 3rd avenue, New York, N.Y. 10022.

Descriptors: *Abstracts, *Bibliographies, *Aquatic life, *Publications, *Biological communities, Ecology, Environment, Aquatic environment, Aquatic habitats, Aquatic animals, Aquatic plants, Aquatic microorganisms.
Identifiers: Aquatic biology.

Aquatic biology abstracts is a monthly publication with an author index and a separate annual author and subject index. The abstracts are in English, but are prepared from original articles appearing in more than fifteen foreign languages. The publication is under the direction of Information Retrieval Limited of London. The journal literature in the field of aquatic biology is screened and abstracted by professional personnel, and abstracts of new patents for thirty-two countries are included as appropriate. Full bibliographic information is shown with each abstract, including author addresses. Papers of pertinence appear in Aquatic biology abstracts within three months of publication. Approximately 7000 abstracts are indexed annually. (Knapp-USGS)
W70-07370

INTERNATIONAL GLOSSARY OF HYDROLOGY - SECOND DRAFT (JULY 1969).

World Meteorological Organization and United Nations Educational, Scientific and Cultural Organization Report, 1969. 138 p.

Descriptors: *Documentation, *Translations, *Hydrology, *International hydrological decade.
Identifiers: *International Glossary of Hydrology.

A second draft is presented of the International Glossary of Hydrology. It contains 1065 equivalent terms in English, Russian, French, and Spanish, but no definitions. The terms are entered alphabetically, with the English equivalent first in each entry. Alphabetical indexes in French, Russian, and Spanish list the terms and entry numbers in the list of equivalent terms. (Knapp-USGS)
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